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GENERAL ELECTRIC CO.
Instrumentation & Control
228 W. Florence Ave.
Inglewood, Calif. 90301

# instruction manual

# model TTS 2762

## MF LOOP SIGNALING DISPLAY

NORTHEAST ELECTRONICS
Airport Road, Concord, New Hampshire 03301 • (603) 224-6521
Subsidiary of Northern Telecom, Inc. • Boston, Mass.

# INSTRUCTION MANUAL

## MODEL

**TTS 2762**

**MF LOOP SIGNALING DISPLAY**

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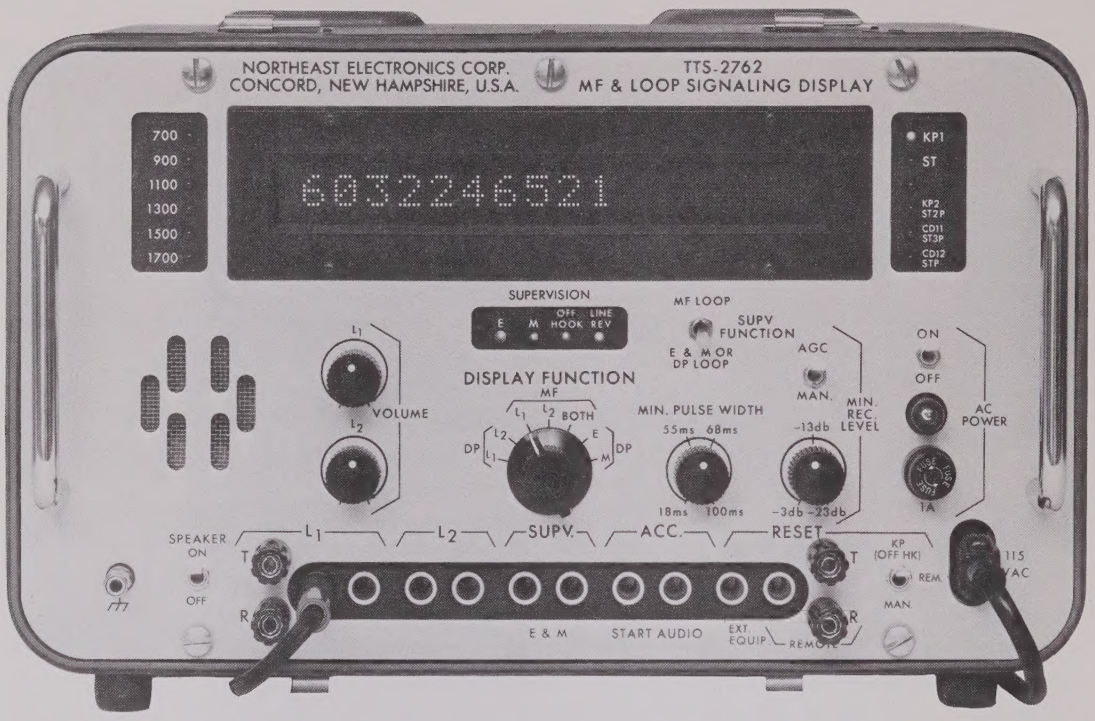


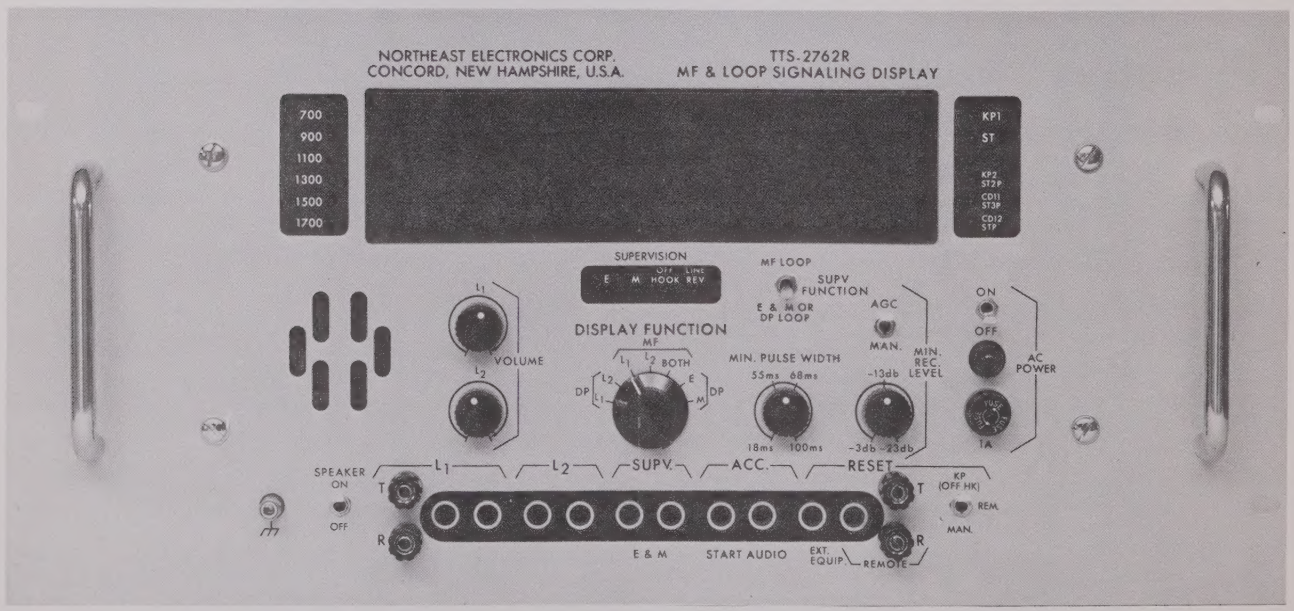




Figure 1–1. TTS 2762 and TTS 2762R MF and Loop Signaling Display Units

# DESCRIPTION

## 1.1 INTRODUCTION.

1.2 The Northeast Electronics Corporation TTS 2762 and TTS 2762R MF and Loop Signaling Display units, figure 1—1, are solid state bridging test sets that display monitored MF codes, digits, supervision, and loop or E or M dial pulsing appearing on standard 2-wire or 4-wire trunks.

1.3 The TTS 2762 test set provides the following: a display of each valid MF tone or dial pulse digit received; MF codes and a collective display of up to sixteen digits that can be reset by any one of three preselected modes of operation (automatic, remote or manual); automatic and manual signal gain controls that are instrumental in diagnosing low level signals or excessive differences in transmission levels; a speaker for audio monitoring; line reversal indication; an adjustable pulse width control to help diagnose marginal or faulty signal transmission; an auxiliary output connector that provides digit data (in BCD format), MF codes, data present and clear, supervision, line reversal and remote reset, for use with auxiliary equipment such as printers, computers and the NEC Model 2765 Call Disposition Analyzer. The use of printers or computers will require interfacing circuitry.

1.4 One of the many applications of the TTS 2762 is in the 2765 Call Disposition Analyzer System. In that system, the TTS 2762 unit monitors individual trunks via a trunk access unit. It interprets the signaling on the trunk and relays the data to the Model 2765 unit for processing.

1.5 The TTS 2762 and 2762R operate on 115 Vac, 50 Hz to 60 Hz, or 230 Vac, 50 Hz to 60 Hz, with option 1.

# SPECIFICATIONS

## 2.1 INTRODUCTION.

2.2 Table 2–1 lists the specifications for the TTS 2762 and TTS 2762R.

**Table 2–1. Specifications**

| | |
|---|---|
| **ELECTRICAL** | |
| MF and DP RECEIVERS ($L_1$ & $L_2$) | |
| Input Impedance | ⩾20K balanced, dc blocked. |
| Input Isolation | 1 Megohm to ground. |
| MF Minimum Sensitivity: | |
| AGC | –25 dBm |
| MAN | –3 dBm to –23 dBm (adjustable) |
| MF Dynamic Range: | |
| AGC | 31 dB |
| MAN | 20 dB (+3 dB, –0 dB or MIN REC LEVEL control setting) |
| Maximum Difference in Transmission Level Between Two Simultaneous Tones | 6 dB |
| MF Tone Filter Band Widths: | |
| AGC | 3% to 5% of center frequency |
| MAN | Depends upon signal level and manual gain setting. |
| Minimum Pulse Width | 18ms, ±5ms to 100ms, ±5ms (adjustable) |
| Minimum Interval Between Pulses | 10 ms |
| REMOTE RESET | |
| Reset Command | Switch closure T to R (⩽100 ohms) or TTL/DTL/RTL logic 0 (R=ground) |
| Command Sequence | Open (logic 1) for ⩾10ms prior to closure (logic 0). Closure (logic 0) for ⩾20ms. |

| | |
|---|---|
| Command Current (logic 1) | I, ≤0.1 mA (sink or source). |
| **EXTERNAL EQUIPMENT RESET** | |
| Contact Rating | 10 watts resistive,<br>50V or 0.5A maximum. |
| **SUPERVISION** | |
| Display: | |
| E lamp lit | $V_{tip}$ more negative than −10 volts (or open) |
| E lamp extinguished | $V_{tip}$ more positive than −10volts |
| M lamp lit | $V_{ring}$ more positive than −22 volts (or open) |
| M lamp extinguished | $V_{ring}$ more negative than −23 volts |
| OFF HOOK lamp lit | $V_{tip}$ or $V_{ring}$ more positive than −5 volts (or open) |
| OFF HOOK lamp extinguished | $V_{tip}$ and $V_{ring}$ more negative than −5 volts |
| LINE REV lamp lit | $V_{tip}$ more negative than $V_{ring}$ (or both open) |
| LINE REV lamp extinguished | $V_{tip}$ more positive than $V_{ring}$ |
| Input Current: | |
| SUPV jacks: | |
| $V_{in}$ = 0 volts | $I_{in} \leq$ 1.5mA (source) |
| $V_{in}$ = −48V | $I_{in} \leq$ 0.1mA (sink) |
| $L_1$ or $L_2$ jacks: | |
| $V_{in}$ = 0 volts | $I_{in} \leq 10\mu$A (source) |
| $V_{in}$ = −48 volts | $I_{in} \leq 300\mu$A (sink) |
| **AUDIO ($L_1$ or $L_2$)** | |
| Input Impedance | ≥20K ohms balanced, dc blocked |
| Input Level | −35 dBm to +10 dBm per line |

| | |
|---|---|
| Output: | $L_1$ and $L_2$ audio added. |
| ACCESSORY AUDIO: | −35 dBm, ±4 dBm to −11 dBm, ±4 dBm (with −25 dBm, ±0.2 dBm input) dependent upon setting of volume controls. |
| ACCESSORY START: | |
| Contact Rating | 115V, 2A maximum. |
| POWER: | |
| Standard | 115Vac, ±10Vac, 50Hz to 60Hz, 60 watts |
| Option 1 | 230Vac, ±20Vac, 50Hz to 60Hz, 60 watts |

## ENVIRONMENTAL

| | |
|---|---|
| OPERATING: | |
| Ambient temperature | +25°C, ±10°C |
| Relative Humidity (no condensation at 50°C) | 0 to 85% |
| STORAGE: | |
| Ambient Temperature | 0°C to 70°C |
| Relative Humidity (no condensation at 50°C) | 0 to 85% |

## MECHANICAL

| | |
|---|---|
| OUTSIDE DIMENSIONS: | |
| Model TTS 2762 | 8.25"w x 14.0"h x 14.25"d (21.0cm x 35.6cm x 36.2cm) |
| Model TTS 2762R | 19.0"w x 8.72"h x 9.78"d (48.3cm x 22.1cm x 27.2cm) |
| HANDLES (both units) | 1.375" beyond front panel (3.5cm) |
| MOUNTING TTS 2762R | Standard 19" rack (48.3cm) rack spacing |
| WEIGHT( either unit) | Approximately 31 lb. (14.1kg) |

## GENERAL

### DISPLAY

#### Numeric:

| | |
|---|---|
| Type | Single plane neon dot matrix |
| Capacity | 16 digits simultaneously |
| Character Size | 0.4"h (1.02cm) x 0.28"w (0.71cm) |

#### MF CODE:

| | |
|---|---|
| Type | Individual LEDs with caption |
| Codes | KP1,KP2/ST2P,ST,CD11/ST3P,CD12/STP |

#### MF Frequency:

| | |
|---|---|
| Type | Individual LEDs with caption |
| Frequency | 700,900,1100,1300,1500, and 1700 Hz |

#### RESET:

| | |
|---|---|
| Type | Automatic (KP/OFF HOOK) remote (REM) or manual (MAN) reset modes |

# INSTALLATION AND OPERATING INSTRUCTIONS

## 3.1 INTORDUCTION.

3.2 This section contains installation and operating instructions for the TTS 2762 and the TTS 2762R. The basic differences between the TTS 2762 and the TTS 2762R are pointed out in paragraph 3–6. The operating instructions are identical for both units. Table 3–1 lists the function of the controls, indicators, and connectors shown on figure 3–2, with their reference designators. Paragraphs 3–7 through 3–65 provide the necessary information for the operation of the TTS 2762 and the TTS 2762R. Table 3–4 is provided for quick reference to frequencies used in MF pulsing.

## 3.3 VISUAL INSPECTION.

3.4 Examine the TTS 2762 or TTS 2762R for obvious damage in shipment. Check the numeric display housing for cracks.

## 3.5 INSTALLATION.

3.6 The TTS 2762R can be mounted in a 19-inch rack for a more permanent installation. Unlike the TTS 2762, 115V ac recessed plug J3 and accessory output connector J2 are brought out to the rear of the unit. Parallel connections to all the 310 jacks in the jack block located on the front panel are brought out to a terminal strip at the rear of the unit, as shown on figure 3–1. The inputs to the TTS 2762R can be connected to any 2 or 4-wire trunk patch bay directly or via a trunk access unit. Refer to Table 3–2 for input selection and connections.

**NOTE**

**Proper Ground Connection**

**The TTS 2762 depends on off-hook conditions to display the DP digits and DP supervision. It is essential that the unit have an earth-ground connection to establish an off-hook response. A proper ground can be insured by the following:**

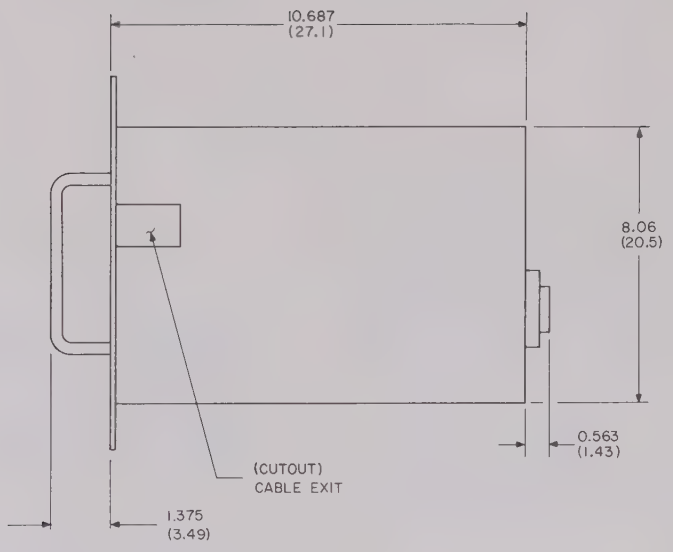
**a. When connecting Belden power cord to an outlet, do not isolate the NEMA ground-lead, and check the outlet to ensure that the third lead is connected to earth ground.**

**b. If the ac-power plug must have its third lead isolated, strap the third lead to a clean main frame ground or connect a lead from connector J18 to a clean, main-frame ground.**

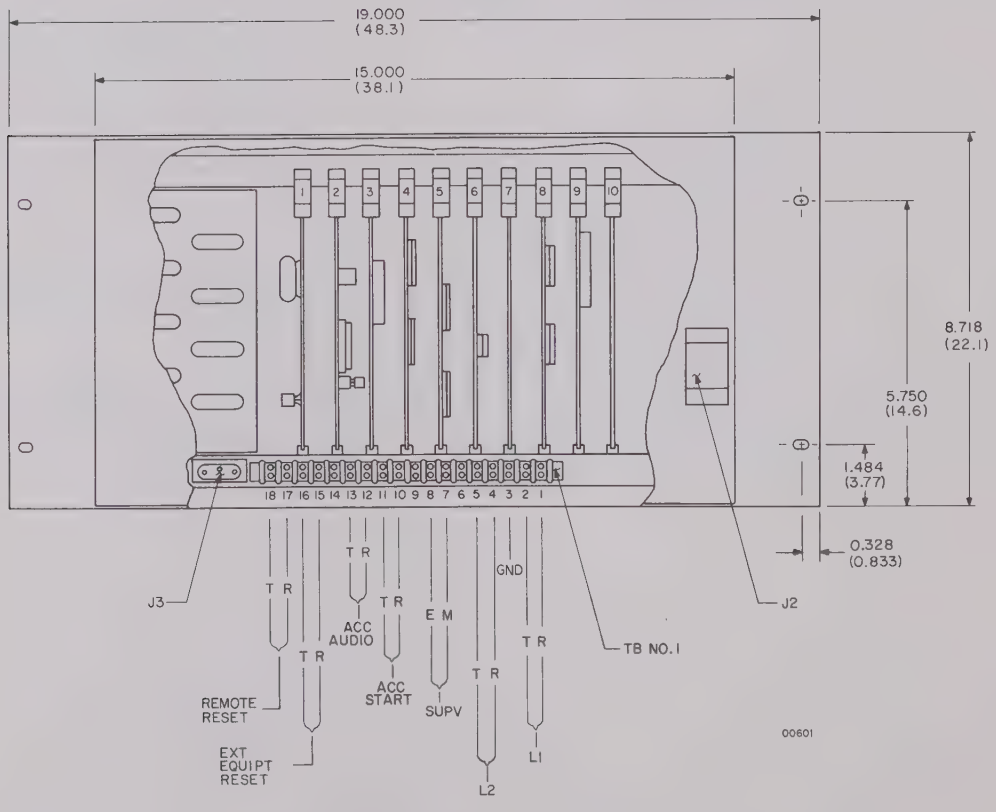
## 3.7 OPERATION.

3.8 Unless otherwise indicated, all operating procedures apply to the TTS 2762R as well as to the TTS 2762.

3.9 Table 3–1 provides a functional description of the controls, indicators, and connectors shown on figure 3–2.




RIGHT SIDE VIEW




REAR VIEW

NOTE
1. ALL DIMENSIONS IN INCHES (CM)

**Figure 3–1. TTS 2762R, Installation Drawing**

Table 3–1. Front Panel Controls, Indicators and Connectors

| Ref Desig. | Control, Indicator or Connector | Function |
|---|---|---|
| DS1 | AC POWER pilot light | When lit, indicates that ac power is applied to internal circuitry. |
| F1 | AC POWER fuse | Provides 1A protection for internal circuitry. |
| J2 | Accessory Output Connector (located on rear of TTS 2762R) | Provides information concerning MF and DP digit data (in BCD format), MF codes and frequencies, data present and clear, supervision, line reversal and remote reset. These outputs are TTL compatible (fan out = 2) and are intended for use with auxiliary equipment such as NEC 2765 Call Disposition Analyzer, printers and computers. |
| J3 | 115 VAC recessed plug (located on rear of TTS 2762R) | Input connector for ac power. |
| J4,J5 J14,J15 | $L_1$ jacks | Connected in parallel, J4,J5 and banana jack binding posts (J14 and J15), provide access to DISPLAY FUNCTION switch and balanced, dc-blocked, high impedance input for selecting and monitoring MF and dial pulse signaling. |
| J6,J7 | $L_2$ jacks | Connected in parallel, J6 and J7 provide access to DISPLAY FUNCTION switch and balanced, dc-blocked, high-impedance input for selecting and monitoring MF and dial pulse signaling. |
| J8,J9 | SUPV E&M jacks | Provides two parallel-connected 310 jacks for monitoring E and/or M supervision and, via DISPLAY FUNCTION switch, E or M dial pulsing for display. |
| J10 | ACC START jack | Only during E&M supervision, it provides an output in form of a dry contact closure rated at 115 VAC, 2 amps, when E or M inputs monitor an off-hook condition. Contacts will stay closed until both E and M leads monitor an on-hook condition. |
| J11 | ACC AUDIO jack | Provides a combined output of the monitored signal on $L_1$ and $L_2$ inputs, depending on volume control settings (R1,R2), but independent of DISPLAY FUNCTION and SPEAKER switch settings (Input Z= 1 kohm, with ring at chassis ground). |
| J12 | EXT EQUIP RESET jack | Provides a dry contact closure across tip and ring when a reset command is received in remote or manual reset operating modes. Contacts rated at 50 volts, 10 watts or 0.5A. |

Table 3–1 (cont)

| Ref Desig. | Control, Indicator or Connector | Function |
|---|---|---|
| J13<br>J16,J17 | REMOTE RESET T–R banana jack, binding post and 310 jack | Inputs for reception of remote reset commands in the form of a contact closure across tip and ring (⩽ 100 ohms) or TTL/DTL/RTL logic 0 (R= ground). |
| J18 | Chassis ground banana jack binding post | Connector for an external common-ground connection. |
| PC1 | KP1,ST,KP2/ST2P,CD11/ ST3P,CD12/STP code display | Indicates reception of respective valid MF codes. Remain lit after signal reception and until reception of a reset command. |
| PC2 | SUPERVISION display (E,M,OFF HOOK,LINE REV) | Indicates off-hook condition when E,M and/or OFF HOOK lamps extinguish; tip-ring reversal when the LINE REV lamp extinguishes.<br>The proper lamp(s), E,M, and/or OFF-HOOK, will flash during dial pulsing.<br>NOTE<br>**The TTS 2762 operates normally whether or not the monitored line is reversed.** |
| PC3 | 700,900,1100,1300,1500,1700, frequency display | Indicates presence of respective MF frequency on $L_1$ or $L_2$ input as selected by DISPLAY FUNCTION switch. |
| R1 | VOLUME, $L_1$ control | Varies speaker volume and output level to ACC AUDIO jack of input signal monitored on $L_1$. |
| R2 | VOLUME, $L_2$ control | Varies speaker volume and output level to ACC AUDIO jack of input signal monitored on $L_2$. |
| R3 | MIN REC LEVEL (–3 dB to –23 dB) control | With AGC/MAN switch in MAN position, this control varies level of input signal below which there will be no display. |
| R4,R5 | MIN PULSE WIDTH control (18ms through 100ms) | Provides an adjustment for setting the minimum acceptable pulse width of any MF or dial pulse. |
| S1 | DISPLAY FUNCTION switch | Selects input jack and type of signaling to be displayed. |
| S2 | AC POWER switch | In ON position, ac power is applied to internal circuitry. |

Table 3–1. (cont)

| Ref Desig. | Control, Indicator or Connector | Function |
|---|---|---|
| S3 | SPEAKER ON/OFF switch | Disconnects speaker, but not ACC AUDIO jack. |
| S4 | MIN REC LEVEL AGC/MAN switch | In AGC position, unit will accept MF input levels from –25 dBm to +6 dBm. MAN position, allows selective minimum MF input level using MIN REC LEVEL control (–3 dB to –23 dB). |
| S5 | RESET switch (KP, OFF HOOK/REM/MAN | In KP, OFF HOOK position, display automatically resets with each KP1 or KP2/ST2P pulse, or an on-hook/off-hook transition (on-hook ⩾210ms, off-hook ⩾60ms) on $L_1$, $L_2$ or E&M input.<br>In REM position, a remote reset command is allowed for complete display reset for an external source via REMOTE RESET jacks J13 or J16 and J17. (Refer to section 2, Specifications, for remote reset commands).<br>Also, external equipment relay will operate with each command.<br>MAN position, is a momentary position. At any time, RESET switch can be depressed to this position for local reset of display and operation of external reset relay. |
| S6 | SUPV FUNCTION switch | MF LOOP position expands capability of DISPLAY FUNCTION switch position, MF $L_1$, to display loop supervision appearing on $L_1$.<br>E&M or DP LOOP position allows monitoring of MF signaling for display on $L_1$ input when the DISPLAY FUNCTION switch is set to DP E or DP M. |
| U1 | Numeric Display | Displays up to 16 digits (MF or DP) simultaneously, with any spillover relpacing previously displayed digits, starting with the first digit. |

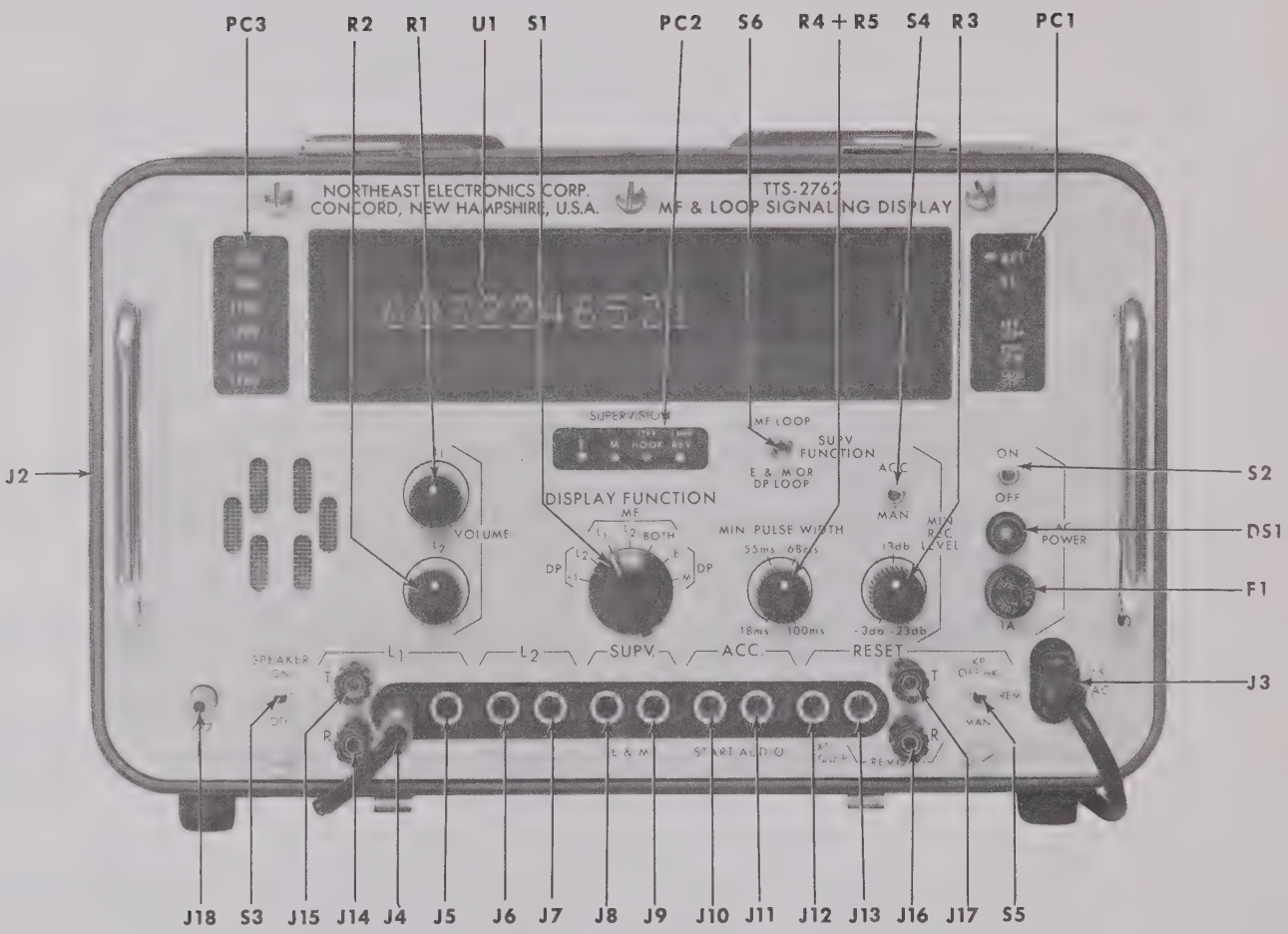



Figure 3–2. TTS 2762, Controls, Connectors, and Indicators

## 3.10 OPERATIONAL CHECK.

3.11 Remove the power cord from the TTS 2762 cover compartment and connect it to the 115 Vac power plug. Insert the other end into a 115 Vac, 60 Hz source.

3.12 Without additional connections to the unit, perform the following pre-operation checkout procedure.

| ACTION | RESULT |
|---|---|
| a. Set AC POWER switch S2 to ON position. | AC POWER pilot lamp lights. Frequency indicators may light for a brief period of time, then extinguish. All SUPERVISION lamps light. MF code lamps may be lit. Numeric display may display random digits. |
| b. Momentarily depress KP (OFF HK) / REM/MAN RESET switch S5 to MAN position. | All frequency and code lamps extinguish. Any digits displayed on the numeric display are extinguished. Supervision lamps remain lit. |

## 3.13 NORMAL CONTROL SETTINGS.

3.14 After performing the operational check, set the TTS 2672 controls as follows:

a. Set KP (OFF HK) /REM/MAN RESET switch S5 to KP (OFF HK) position.

b. Set MIN PULSE WIDTH control R4 and R5 to full ccw position. (18ms)

c. Set MIN REC LEVEL, AGC/MAN switch S4 to AGC position. This allows the unit to recognize, for display, MF signal levels from −25 dBm to +6 dBm on a selected input.

d. Set MIN REC LEVEL control R3 to −13 dB position.

e. Set $L_1$ and $L_2$ VOLUME controls R1 and R2 to mid-range.

f. Set SPEAKER switch S3 to ON position. Speaker will produce an audible output of signaling transmitted and/or received on $L_1$ and $L_2$.

g. Set DISPLAY FUNCTION switch S1 as indicated in paragraph 3.15 and Table 3–2.

h. Set SUPV FUNCTION switch S8 as indicated in paragraph 3.15 and Table 3–2.

## 3.15 INPUT SELECTION, PATCHING AND SUPERVISION.

3.16 Determine the type of signaling and supervision to be monitored, then refer to Table 3–2 for the following:

a. SUPV FUNCTION switch position setting.

b. DISPLAY FUNCTION switch position setting to select the signaling input to be monitored and displayed.

c. Patching from TTS 2762 $L_1$, $L_2$, and SUPV jack(s) to patch bay output jack(s).

d. Supervision Lamps affected will extinguish when their respective supervision is monitored. All supervision lamps are normally lit with on-hook and no line reversal conditions monitored. The E and M lamps extinguish when an off-hook condition is monitored on E and M jacks. The OFF HOOK lamp extinguishes when an off-hook condition is monitored on $L_1$ or $L_2$ jacks, or on the E&M jacks during E&M dial pulsing. The proper lamp(s) (E,M, and/or OFF HOOK) will flash during dial pulsing when its associated type of signaling is monitored.

**Table 3–2. Input Selection, Patching and Supervision**

| A. Monitoring Multifrequency (MF) Signaling with E&M Supervision | | | | |
|---|---|---|---|---|
| 1. Set SUPV FUNCTION switch to E&M or DP LOOP position. | | | | |
| Line Pairs to be Monitored | DISPLAY FUNCTION Switch Position | Patching* | | Supervision Lamps Affected |
| | | From 2762 | To Patch Bay | |
| 1 | MF,$L_1$ or<br>MF,$L_2$ | $L_1$ or $L_2$ | $T_1$ and $R_1$ | |
| | | E&M | E lead and/or M lead | E and/or M** |
| 2 | MF,$L_1$ or<br>MF, $L_2$ or<br>MF, both | $L_1$ and $L_2$ | $T_1$ and $R_1$<br>$T_2$ and $R_2$ | |
| | | E&M | E lead and M lead | E and M** |

Table 3–2. (cont)

| Line Pairs to be Monitored | DISPLAY FUNCTION Switch Position | Patching* From 2762 | Patching* To Patch Bay | Supervision Lamps Affected |
|---|---|---|---|---|
| B. Monitoring MF Signaling with Loop Supervision. | | | | |
| 1. Set SUPV FUNCTION switch to MF Loop position. | | | | |
| 1 | MF, $L_1$ | $L_1$ | $T_1$ and $R_1$ | OFF HOOK and LINE REV |
| C. Monitoring Loop Dial Pulse (DP) Signaling with Loop Supervision. | | | | |
| 1. Set SUPV FUNCTION switch to E&M or DP LOOP position. | | | | |
| 1 | DP,$L_1$ or DP, $L_2$ | $L_1$ or $L_2$ | $T_1$ and $R_1$ | OFF HOOK and LINE REV |
| 2 | DP, $L_1$ or DP, $L_2$ | $L_1$ and $L_2$ | $T_1$ and $R_1$<br>$T_2$ and $R_2$ | OFF HOOK and LINE REV |
| D. Monitoring E and/or M DP Signaling with Loop Supervision. | | | | |
| 1. Set SUPV FUNCTION switch to E&M or DP LOOP position.<br>2. If voice monitor is desired with the speaker and/or the AUDIO ACC jack, patch the tip and ring to $L_1$ or $L_2$ as indicated. Set the SUPV FUNCTION switch to the MF, LOOP position to disconnect the MF receivers and prevent false MF codes or digits that may be caused by speech or transients. | | | | |
| 1 | DP,E | E&M $L_1$ or $L_2$ | E lead $T_1$ and $R_1$ | E and OFF HOOK |
| 2 | DP,M | E&M $L_1$ or $L_2$ | M lead $T_1$ and $R_1$ | M and OFF HOOK |

NOTES:

*1. In all cases, make connections from the TTS 2762 to the patch bay to maintain continuity in the transmission path. Always use 241 jacks (dual 310) unless bridging monitor plugs are available, in which case, single 310 jacks can be used.

*2. $L_1$ and $L_2$ and continuously monitored for audio reproduction via the speaker or the ACC AUDIO jack. The speaker can be turned off by speaker switch S3.

**3. TTS 2762 will function properly without E&M supervision, except E and M supervision lamps stay lit and accessory start feature will not operate. Accessory start feature is operational only when E or M inputs sense an off-hook condition.

## 3.17 REMOTE RESET OPERATION.

3.18 In this mode of operation, the display will reset only when triggered by a remote reset command. For remote reset operation:

| ACTION | RESULT |
|---|---|
| a. Connect external reset command source to REMOTE 310 jack J13, or T–R banana jack binding posts J16 and J17. (Refer to Specifications for REMOTE RESET commands). | |
| b. Set KP (OFF HK) /REM/MAN RESET switch S5 to REM position. | |

## 3.19 DIAGNOSTIC OPERATION IN MULTIFREQUENCY (MF) SIGNALING SYSTEMS.

3.20 The TTS 2762 is helpful in troubleshooting marginal or inoperative MF Systems. The line under observation is assumed to be out of service so that a known sequence of MF pulses can be sent at machine or manual rates.

## 3.21 DETECTING INSUFFICIENT OR EXCESSIVE COMPONENT FREQUENCIES (MACHINE SEND).

3.22 The TTS 2762 can be used to determine when one or three or four more frequencies in an MF signal are being transmitted simultaneously.

3.23 To detect the MF signaling in error, proceed as follows:

| ACTION | RESULT |
|---|---|
| a. Connect TTS 2762 to one end of line in question as described in paragraphs 3.13 through 3.16. | |
| b. Set MIN PULSE WIDTH control R4 and R5 to standard pulse width expected from sender. | |
| c. Transmit a known sequence of MF signals representing all digits from the suspect sender. | Frequency lamps lit for duration of associated MF signals. (Refer to paragraph 3.16,d). SUPERVISION lamps associated with line condition, extinguish. MF signals longer than MIN PULSE WIDTH control R4 and R5 setting with levels greater than –25 dBm will be displayed. Speaker provides audio output of input signals on $L_1$ and/or $L_2$. |

3.24 Observe the frequency lamps during transmission for the number of frequencies included in each MF signal, and check the numeric and code displays for those MF signals acceptable to the TTS 2762.

3.25 If only one frequency of an MF signal is transmitted, the respective frequency lamp will light, but no digit or code will be displayed. If two frequencies are transmitted, the respective frequency lamps will light, and the digit or code representing the frequency pair will be displayed. If three or more frequencies are transmitted, the respective frequency lamps will light, but the unit, in most cases, will not attempt to decode the signal.

3.26 The MF signal will not be rejected when the transmission of its frequencies are not simultaneous; but staggered in such a way that the first two frequencies transmitted are present for a minimum length of time set by the MIN PULSE WIDTH control before a third, or more, frequency is transmitted. To cause rejection of this type of stagger-start frequency transmission of an MF signal, increase the MIN PULSE WIDTH control setting clockwise to some point just below the standard pulse width of the sender in question. The adjustment will increase the time that the TTS 2762 will have to recognize a third frequency for rejection of any code or digit from being displayed.

### 3.27 DETECTING SHORT MF PULSES (MACHINE SEND).

3.28 If MF signaling errors are noted on machine pulsed numbers, but not on manually pulsed numbers from the same MF supply oscillators, short pulses may be the cause. The TTS 2762 can be used to determine if short pulses are being sent or received. However, since channel distortion is possible, a valid transmitted signal in office A does not guarantee a valid received signal at office B. Both ends of the circuit should be checked.

3.29 To check for short MF signal pulses and/or the approximate length of any MF signal pulses, proceed as follows:

| ACTION | RESULT |
|---|---|
| a. Connect TTS 2762 to one end of line in question as directed in paragraphs 3.13 through 3.16. | |
| b. Transmit a known sequence of MF signals representing all digits from the suspect sender. | Frequency lamps light for duration of associated MF signals. (Refer to paragraph 3.16,d).<br>SUPERVISION lamps associated with line condition, extinguish.<br>MF signals longer than the MIN PULSE WIDTH control setting (18ms), with levels from −25 dBm to +6 dBm, will be displayed.<br>Speaker provides audio output of input signals on $L_1$ and/or $L_2$. |

3.30 Repeat the procedure above several times each time turning the MIN PULSE WIDTH control clockwise, in small increments, increasing the minimum pulse width acceptable by the unit. In this way, the approximate length of each MF pulse sent in sequence can be determined.

### 3.31 DETECTING EXCESSIVE DIFFERENCE IN TRANSMISSION LEVELS, LOW SIGNAL LEVEL.

3.32 If particular MF signals, or groups of signals using a common frequency, fail to register correctly, even on slow manual send, one or more of the MF frequencies may be significantly lower than the others in amplitude.

3.33 If registration is generally erratic, even on slow manual send, the signals may all be too low in amplitude.

3.34 Both conditions can usually be detected using the TTS 2762 as follows:

| ACTION | RESULT |
|---|---|
| a. Connect TTS 2762 to line in question as described in paragraphs 3.13 through 3.16.<br>b. Using a manual sender, very slowly, transmit a known sequence of MF signals representing all digits. | Frequency lamps light for duration of associated MF signals of proper levels. (Refer to paragraph 3.16,d) SUPERVISION lamps associated with line condition, extinguished.<br>MF signals >18ms long, with levels from −25 dBm to +6 dBm, should be displayed. Speaker provides audio output of input signals on $L_1$ and/or $L_2$. |

3.35 Observe the frequency lamps during signal transmission and check for proper lamp pairs lighting during transmission of their associated frequencies. (Refer to Table 3–4).

3.36 If the expected display for the known sequence of transmitted MF signals is in error, excessive transmission level differences may be present. That is, one or more of the frequencies in the MF signaling are 6 dB or more, lower in level than their complementary frequency.

3.37 When the proper transmission level on the monitored trunk is known, check the frequencies in question as follows:

| ACTION | RESULT |
|---|---|
| a. Set AGC/MAN switch S4 to MAN position.<br>b. Set MIN REC LEVEL control R3 slightly lower than proper transmission level. (e.g., proper level = −12 dBm; set MIN REC LEVEL control to approximately −14 dBm).<br>c. Transmit a known sequence of MF signals, preferably representing all digits and one code. | SUPERVISION lamps associated with line condition, extinguish.<br>MF signaling with a level greater than MIN REC LEVEL control R3 setting will have its associated frequency lamps light for duration of signal.<br>Codes or digits will be displayed only if both of their associated pair of frequencies are greater than the MIN REC LEVEL control setting. Speaker provides audio output of input signals on $L_1$ and/or $L_2$. |

3.38 While the known sequence of MF signaling is being transmitted, observe the frequency lamp to determine which MF signals include a frequency too low in level as determined by the MIN REC LEVEL control setting, (e.g., If the MIN REC LEVEL control is set at −14 dB, only those MF signals will be displayed whose associated frequencies are both greater than approximately −14 dB). If the pulse rate is too fast to observe the exact frequency failures, then, by refering to Table 3−4, and observing which signals are not displayed, the low level frequency or frequencies can be found by determining the common frequency or frequencies.

3.39 For example: MF signals KP,1,3,6,0,CD11 (or ST3P), and ST are transmitted. The display shows KP,1,0,CD11, and ST. Digits 3 and 6 were not displayed. Refering to Table 3−4, 1100 Hz is found to be common with digits 3 and 6. Therefore, 1100 Hz frequency is lower in level than the other component frequencies of digits 3 and 6 (900 Hz 1100 Hz and 1300 Hz).

3.40 Because the frequency levels may be staggered, the best test is to receive a known sequence of transmitted MF signals representing all digits and codes in the system that is recognized by the TTS 2762.

3.41 If the proper transmission level on the monitored trunk is unknown, perform the same ACTION as described in paragraph 3.34, except set MIN REC CONTROL R3 to −23 dBm in step b.

3.42 While receiving the known series of MF signaling, turn MIN REC LEVEL control R3 counterclockwise until an inconsistent display is obtained. Note the code(s) or digit(s) that failed. Then turn MIN REC LEVEL control R3 clockwise until the same code(s) or digit(s) are displayed consistently. The position of the MIN REC LEVEL control will indicate the approximate level of the code(s) or digit(s) noted. Refer to the example in paragraph 3.39 and proceed to investigate the individual frequencies.

NOTE

**The lower signal level threshold of the unit is more sensitive than the upper threshold. For example, with the MIN REC LEVEL control set at −10 dBm,−13 dBm would probably not be accepted, whereas a signal set at −7 dBm would.**

3.43 DIAGNOSTIC OPERATION IN DIAL PULSE SYSTEMS.

3.44 The TTS 2762 can be helpful in troubleshooting marginal or inoperative dial pulse systems. The line under observation is assumed to be out of service so that a known sequence of dial pulses can be transmitted at machine or manual rates.

3.45 If signaling errors appear in the system, the TTS 2762 can be used to detect whether too short a series of pulses for a known digit is being transmitted, or if the length of the transmitted pulses have too short a duration (pulse width, on-hook or break interval).

3.46 DETECTING MISSING DIAL PULSES.

3.47 To detect the missing pulses, proceed as follows:

| ACTION | RESULT |
|---|---|
| a. Connect TTS 2762 to line in question as described in paragraphs 3.13 through 3.16 | |
| b. Using a manual sender, transmit a known sequence of DP signals representing all digits. | Representative supervision lamps extinguish. (Refer to paragraph 3.16,d). Known sequence of digits will be displayed if dial pulses (on-hook time) are |

| ACTION | RESULT |
|---|---|
| | longer than the MIN PULSE WIDTH control setting of 18ms. Speaker provides audio output of input signals on $L_1$ and/or $L_2$. |

3.48 While the known series of DP signals are being transmitted, missing pulses can be detected by the following observations:

a. Hearing switching sounds monitored by speaker in loop dial pulsing (E or M dial pulsing is not monitored by speaker).

b. Visual observations of OFF HOOK lamp flashing with each pulse in a series.

c. Numeric display of monitored dial pulses having pulse widths longer than the MIN PULSE WIDTH control setting. This method of detection is particularly helpful when monitoring high speed transmission. The numeric display directly reflects the pulse count of each pulse train transmitted in a known sequence of DP signaling.

### 3.49 DETECTING SHORT DIAL PULSES.

3.50 The TTS 2762 can be used to determine if one or more pulses in a series of pulses, representing a digit, have too short a duration ( pulse width, on-hook or break interval). This can be done whether or not the standard pulse width of the sending equipment is known.

3.51 When only the standard speed (pulses per second) and percent break are known, the standard pulse width can be calculated using the following pulse width formula:

$$\text{Pulse Width (ms)} = \frac{\text{\% Break}}{\text{Speed (PPS)}}$$

3.52 To determine if the DP signaling of the digits transmitted are correct, refer to paragraphs 3.48a,b,c, and then perform the following actions:

| ACTION | RESULT |
|---|---|
| a. Connect TTS 2762 to line in question as described in paragraphs 3.13 through 3.16. | |
| b. Set MIN PULSE WIDTH control R4 and R5 a few milliseconds less than proper pulse width (e.g., If proper pulse width = 72ms; set MIN PULSE WIDTH control to 68ms). | |
| c. Transmit a known sequence of DP signals that represent all the digits on monitored trunk. | Representative supervision lamps extinguish. (Refer to paragraph 3.16d). Known sequence of digits will be displayed if dial pusles (on-hook time) are longer than MIN PULSE WIDTH control (R4 and R5 settings. Speaker provides audio output of input signals on $L_1$ and/or $L_2$. |

3.53 If the TTS 2762 display is incorrect because one or more pulses were unacceptable to the unit, note those digits in error and proceed to investigate them individually.

3.54 Turn MIN PULSE WIDTH control R4 and R5 counterclockwise several milliseconds and transmit the DP signaling of a digit in question. Repeat this procedure with the same digit until the display agrees with the DP signaling. The MIN PULSE WIDTH control setting will indicate the approximate minimum pulse width in the DP signaling of the digit transmitted. Example: A 10 pps sender operating at 70% break on a loop supervision trunk is causing the receiver to produce an occasional erroneous output. The DP signal of digit eight is being recognized by the receiver as the digit six. To diagnose this problem, proceed as follows:

a. Calculate the pulse width.

$$\text{Pulse Width} = \frac{70\%}{10 \text{ pps}} \times 10 = 70\text{ms}$$

b. Set MIN PULSE WIDTH control R4 and R5 to approximately 68ms.

c. Since the DP signal for digit eight is in error, transmit it from the suspect sender for monitoring with the TTS 2762.

d. Count the flashes of the off-hook lamp and listen for the switching sounds from the speaker during transmission. Assume that a six was displayed while eight pulses were heard.

e. Turn MIN PULSE WIDTH control R4 and R5 to approximately 60ms and transmit the same signal. Assume that a seven is displayed.

f. Turn MIN PULSE WIDTH control R4 and R5 counterclockwise a few more milliseconds and repeat the transmission. This is done until an eight is displayed.

g. This test has shown the approximate pulse widths to be; six pulses greater than 67ms, one pulse greater than 60ms, and one pulse greater than the last MIN PULSE control setting.

3.55 If the standard pulse width, percent break, or sender speed, is not known, the approximate minimum pulse width for a series of pulses may be determined by setting the MIN PULSE WIDTH control to 18ms and alternating transmission of a series of pulses in question, with clockwise adjustments of the MIN PULSE WIDTH control. This is done until a feeling for the standard pulse width is obtained. Since the standard pulse width is determined, the procedure of determining short pulses can be followed.

3.56 OPERATION IN CAMA SYSTEMS.

3.57 The TTS 2762 can be used to monitor Automatic Number Identification (ANI), Operator Number Identification (ONI), or Centralized Automatic Message Accounting (CAMA) systems.

3.58 The anticipated sequence of data is as follows:

a. Called Number (MF, loop DP, or E&M DP).

b. Wink Pulse (if any) the 140ms on-hook/off-hook/on-hook transitions.

c. KP ($KP_1$ or $KP_2$)

d. One Information Digit, 0—5 (MF)

e. Calling Number (MF)

f. ST

3.59 DATA INTERPRETATION.

3.60 Interpret the data as follows:

a. Digital Data. Presented from left to right across the numeric display as received, whether MF, Loop DP, or E&M DP. If more than 16 digits are received before a reset command is issued, the seventeenth digit replaces the first, the eighteenth digit replaces the second, etc.

b. MF Frequencies and Codes. The frequency lamps will remain lit for the duration of the tone present. The codes will activate the proper lamps when present. These code lamps will remain lit until reset.

c. Line Status. The SUPERVISION lamps reflect the status of lines attached to the front panel jacks. Should $L_1$ reverse, the LINE REV lamp will extinguish. Off-hook, dialing, and any wink pulse may be observed by the negative logic operation of the OFF HOOK lamp. The E or M lamps will operate in the same manner, and slightly ahead of the OFF HOOK lamp, when E&M dial pulsing is being monitored.

3.61 CONNECTIONS, CONTROL SETTINGS AND OPERATION.

3.62 Set the controls as follows:

a. Speaker Switch S3 ON.

b. $L_1$ Volume control R1 midrange.

c. AGC/MAN switch S4 AGC.

d. MIN PULSE WIDTH control R4 and R5 18ms.

e. AC POWER switch S2 ON.

f. Connect tip and ring to $L_1$ (J4,J5, or J14 and J15).

g. Connect the E and/or M lead, when appropriate, to the E&M jacks (J8,J9).

h. Depending on the type of signaling monitored, set DISPLAY FUNCTION, S1 SUPV FUNCTION S6, and RESET S5 switches as indicated in Table 3–3.

3.63 Use of the Reset Switch in CAMA Applications. The digit display and MF code lamps can be extinguished at any time by depressing the reset switch to the MAN position. Normally, the instrument can be operated in the remote reset mode. If the automatic (KP/OFF HK) mode were used, a wink pulse might be interpreted as a reset command, and all previously received data would be cleared.

3.64 For Loop DP– or E&M DP– MF operations without a wink pulse, the automatic reset mode may be desirable. Switching transients, or speech, may cause the MF detectors to falsely activate code lamps. The KP signal preceeding the calling number will extinguish these lamps but **not** the DP digits on the numeric display. The subsequent ST will latch the instrument, preventing reception of any further MF signals until a reset command is received. The on-hook/off-hook transition preceeding the next called number constitutes a reset.

3.65 For Loop DP or E&M DP systems having a wink pulse, the instrument may be operated in the REM reset mode to avoid KP or on-hook/off-hook resets. If transients or speech cause false MF code lamp activation, turn the MIN PULSE WIDTH potentiometer clockwise to decrease these errors. Set the pulse width to some point just below the minimum anticipated dial pulse width or MF tone duration. Any in-band signals including, speech transients, of shorter duration than this setting will be ignored.

**Table 3–3. CAMA Operation Control Settings**

| Monitored Signaling | Loop DP– MF | E DP– MF | M DP– MF | MF– MF |
|---|---|---|---|---|
| DISPLAY FUNCTION Switch S1 Position | MF,$L_1$ | E | M | MF,$L_1$ |
| SUPV FUNCTION Switch S6 Position | MF, Loop | E&M | E&M | E&M |
| RESET Switch S5 Position | Remote | Remote | Remote | KP/OFF HOOK |

3.66 For MF–MF operations, the automatic reset mode would ordinarily be more desirable. The ST following the called number will latch the instrument; no further MF data will be displayed until a reset command is received. The wink pulse, if any, and the KP code preceeding the calling number, will provide the needed reset command. Once released from latch, the calling number, information digit, and codes will be displayed.

**Table 3–4. Multifrequency Signaling Recognized by the TTS 2762**

| Digit | Frequencies (Hz) |
|---|---|
| 1 | 700 + 900 |
| 2 | 700 + 1100 |
| 3 | 900 + 1100 |
| 4 | 700 + 1300 |
| 5 | 900 + 1300 |
| 6 | 1100 + 1300 |
| 7 | 700 + 1500 |
| 8 | 900 + 1500 |
| 9 | 1100 + 1500 |
| 0 | 1300 + 1500 |

| Code | Frequencies (Hz) | Explanation | System |
|---|---|---|---|
| KP | 1100 + 1700 | Prep. for digits | |
| Coin Return | 1100 + 1700 | Coin Return | Coin Control |
| KP1 | 1000 + 1700 | Terminal Call | CCITT #5 |
| ST | 1500 + 1700 | End of Pulsing Seq. | |
| STP | 900 + 1700 | | TSPS |
| CD12 | 900 + 1700 | Delay Operator | CCITT #5 |
| ST2P | 1300 + 1700 | | TSPS |
| KP2 | 1300 + 1700 | Transit Call | CCITT #5 |
| ST3P | 700 + 1700 | | TSPS |
| Ringback | 700 + 1700 | Ringback | Coin Control |
| CD11 | 700 + 1700 | Inward Operator | CCITT #5 |
| Coin Collect | 700 + 1100 | Coin Collect | Coin Control |

# CIRCUIT DESCRIPTION

## 4.1 INTRODUCTION.

4.2 The circuit descriptions appearing in this section are written on a functional block diagram level. The active components contained within the functional blocks are identified by their reference designators and are easily cross-referenced to the appropriate detailed schematic diagram in Section 7. The block diagram level description is based on five functional block diagrams of the overall schematic diagram, figure 7—1. They represent the signal processing involved in audio reproduction and four major modes of operation, dependent on the DISPLAY FUNCTION and SUPERVISION FUNCTION switch settings. The block diagram level descriptions are followed by a detailed circuit description keyed to the block diagrams and schematic diagrams.

## 4.3 BLOCK DIAGRAM DESCRIPTION.

## 4.4 REPRODUCTION OF AUDIO.

4.5 Referring to figure 4—1, the signals appearing on the $L_1$ and $L_2$ inputs are monitored at all times via two high-impedance, dc-blocked, balanced transformers. The signals are then applied to two separate high-pass filters. At this point, the signals are also routed to transmission gates through two MF amplifiers, where MF signaling can be selected to be processed for display.

4.6 After the high-pass filters, the signals are amplified and applied to voltage dividers incorporating two volume controls, R1 and R2. The signals are summed, amplified, and routed to the speaker switch and an attenuator. The other side of the speaker switch is connected to speaker LS1 while the output of the attenuator is connected to ACC AUDIO jack J11.

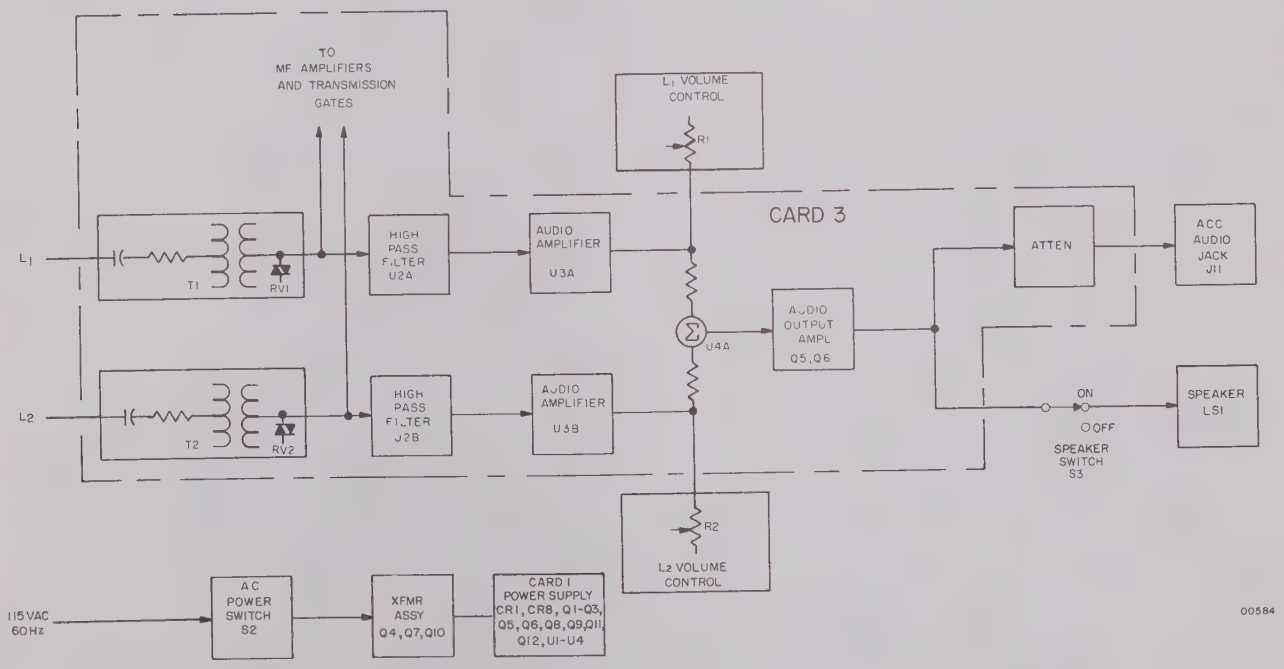



**Figure 4—1. TTS 2762, Audio Processing and Power Supply Block Diagram**

## 4.7 LOOP DP SIGNAL PROCESSING.

4.8 As shown on figure 4–2, loop DP signaling appearing on $L_1$ or $L_2$ can be selected for monitoring by using DISPLAY FUNCTION switch S1 in the positions shown. This switch also provides a signal path from the loop dial pulse monitor to the 60ms off hook timer, on hook timer, and pulse width comparator.

4.9 Loop DP signaling appearing on the $L_2$ input is routed to a line reversal detector and a loop dial pulse monitor via the DISPLAY FUNCTION switch. The line reversal detector inhibits the lamp driver, which in turn extinguishes the LINE REV lamp on PC2.

4.10 The loop dial pulse monitor provides a positive-going pulse when off hook conditions are monitored on the input. Thus, when dialing is initiated, the alternate off hook-on hook condition causes the dial pulse detector to produce a series of pulses. This output is routed via the DISPLAY FUNCTION switch to the 60ms off hook timer, on hook timer, and the pulse width comparator.

4.11 The signaling is now analyzed by the 60ms off hook timer and the pulse width comparator. The output of the off hook timer performs three functions: enables Q5, extinguishing the OFF HOOK supervision lamp; initiates a system reset pulse via the reset switch S5 (KP OFF HOOK) position; and gates U9, allowing dial pulse information to reach the binary counter. The pulse width comparator and the on hook timer measure the on hook interval of the input pulses, comparing them to the electrical conditions set by MIN PULSE WIDTH control R5.

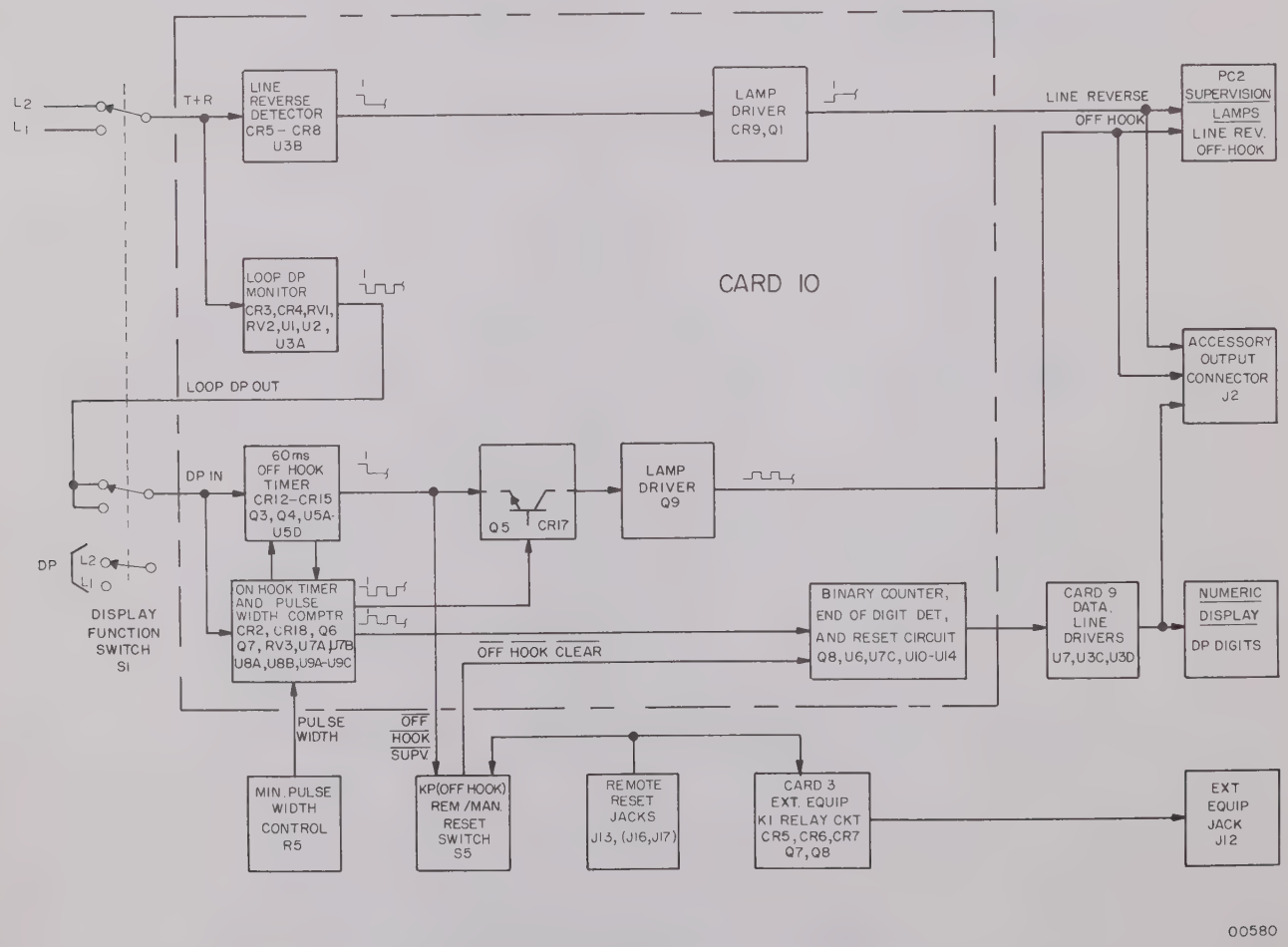

L2
L1
T+R
LINE REVERSE DETECTOR CR5 – CR8 U3B
LAMP DRIVER CR9, Q1
LINE REVERSE
OFF HOOK
PC2 SUPERVISION LAMPS LINE REV. OFF-HOOK
CARD 10
LOOP DP MONITOR CR3, CR4, RV1, RV2, U1, U2, U3A
LOOP DP OUT
ACCESSORY OUTPUT CONNECTOR J2
DP IN
60ms OFF HOOK TIMER CR12–CR15 Q3, Q4, U5A–U5D
Q5
CR17
LAMP DRIVER Q9
DP
L2
L1
DISPLAY FUNCTION SWITCH S1
ON HOOK TIMER AND PULSE WIDTH COMPTR CR2, CR18, Q6 Q7, RV3, U7A, U7B U8A, U8B, U9A–U9C
BINARY COUNTER, END OF DIGIT DET, AND RESET CIRCUIT Q8, U6, U7C, U10–U14
CARD 9 DATA LINE DRIVERS U7, U3C, U3D
NUMERIC DISPLAY DP DIGITS
OFF HOOK CLEAR
PULSE WIDTH
OFF HOOK SUPV
MIN. PULSE WIDTH CONTROL R5
KP (OFF HOOK) REM/MAN. RESET SWITCH S5
REMOTE RESET JACKS J13, (J16, J17)
CARD 3 EXT. EQUIP K1 RELAY CKT CR5, CR6, CR7 Q7, Q8
EXT EQUIP JACK J12
00580

**Figure 4–2. TTS 2762, Loop DP Signal Processing, Block Diagram**

4.12 At this point, the signaling is either rejected or accepted for further processing. If the signaling is accepted by the comparator, two outputs are generated. One output provides a reverse bias to the base of Q5 coincident with the on-hook portion of the signaling. This enables the lamp driver to light the OFF HOOK lamp during the on-hook time of the signaling.

4.13 The second output of the comparator drives the binary counter and end of digit detector. The binary counter produces a BCD output that is timed by an end of digit detector. If 260 milliseconds have elapsed since the last on-hook signal, the end of digit detector will simultaneously generate a data present pulse to gate the BCD information to the line drivers.

4.14 All commands from the reset circuit and the BCD information are routed to numeric display and ACCESSORY OUTPUT connector J2 via the data line drivers.

4.15 The reset cycle can be triggered three ways: by a 60 millisecond off-hook condition on the line that follows an on-hook condition greater than 210 milliseconds; a remote reset input; or a manual switch operation. All three methods of reset are selected by KP (OFF HOOK)/REM/MAN switch S5. A reset pulse generated by any one of the methods mentioned above will clear the numeric display.

4.16 E&M DP SIGNAL PROCESSING.

4.17 To monitor E or M dial pulse signaling for

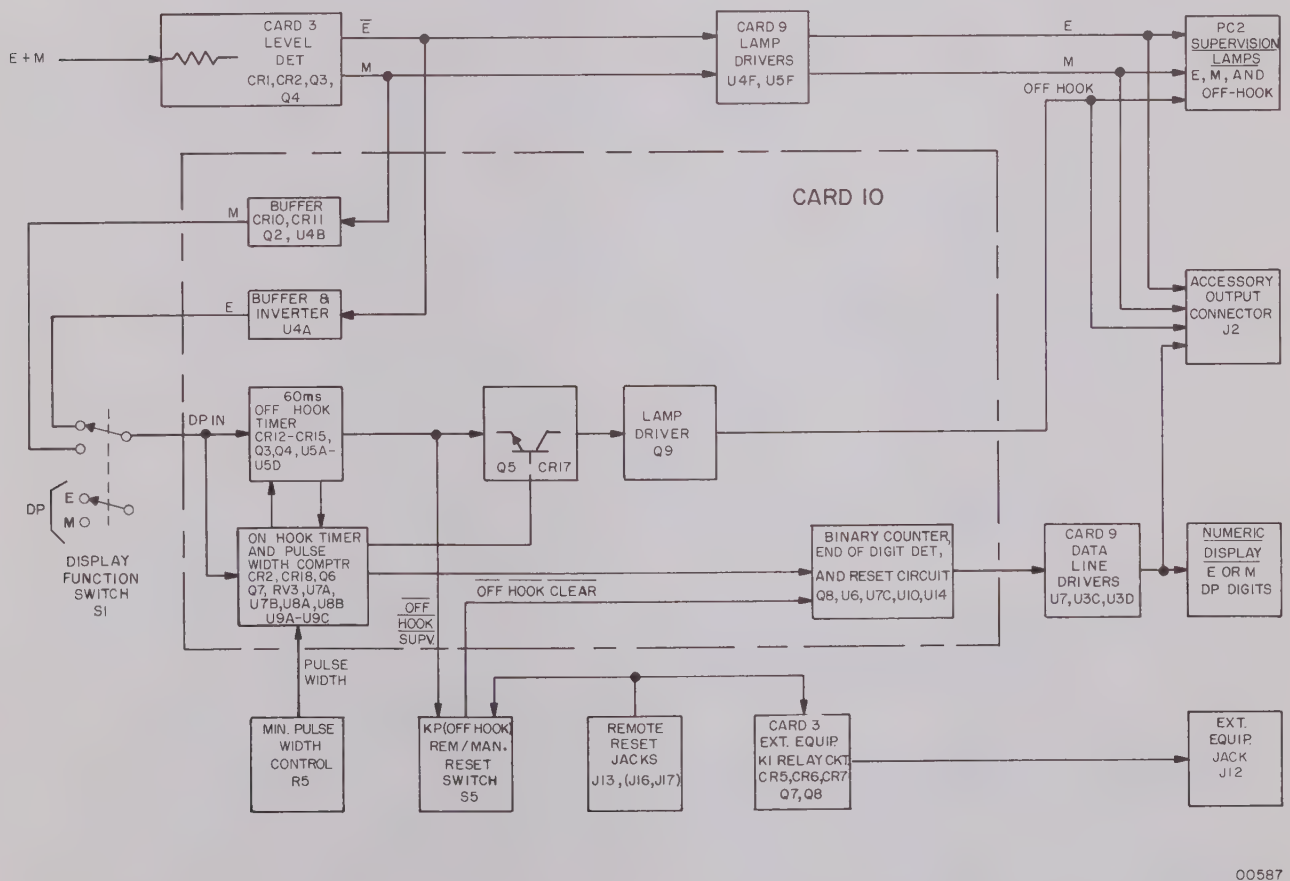

E+M
CARD 3 LEVEL DET CR1,CR2,Q3, Q4
Ē
M
CARD 9 LAMP DRIVERS U4F, U5F
E
M
OFF HOOK
PC2 SUPERVISION LAMPS E, M, AND OFF-HOOK
CARD IO
M
BUFFER CR10,CR11 Q2, U4B
E
BUFFER & INVERTER U4A
ACCESSORY OUTPUT CONNECTOR J2
DP IN
60ms OFF HOOK TIMER CR12-CR15, Q3,Q4, U5A-U5D
Q5 CR17
LAMP DRIVER Q9
DP
E
M
O
DISPLAY FUNCTION SWITCH S1
ON HOOK TIMER AND PULSE WIDTH COMPTR CR2, CR18, Q6 Q7, RV3, U7A, U7B, U8A, U8B U9A-U9C
OFF HOOK CLEAR
OFF HOOK SUPV
BINARY COUNTER, END OF DIGIT DET, AND RESET CIRCUIT Q8, U6, U7C, U10, U14
CARD 9 DATA LINE DRIVERS U7, U3C, U3D
NUMERIC DISPLAY E OR M DP DIGITS
PULSE WIDTH
MIN. PULSE WIDTH CONTROL R5
KP(OFF HOOK) REM/MAN. RESET SWITCH S5
REMOTE RESET JACKS J13, (J16, J17)
CARD 3 EXT. EQUIP. KI RELAY CKT. CR5, CR6, CR7 Q7, Q8
EXT. EQUIP. JACK J12
00587

**Figure 4–3. TTS 2762, E and M DP Signaling Processing Block Diagram**

numeric display, (figure 4–3), the DISPLAY FUNCTION switch is set to either DP E or DP M. In this mode of operation the DISPLAY FUNCTION switch routes the desired E or M signaling from its associated buffer and inverter outputs on card 10 to the 60ms off-hook timer, the on-hook timer, and the pulse width comparator.

4.18 E or M dial pulsing is received directly from E&M jacks J8 and J9 by the high-impedance input of the level detector. The level detector senses ground on the E lead and central office battery on the M lead.

4.19 If E dial pulse signaling is monitored, a train of negative-going pulses will appear at the $\overline{E}$ output of the level detector. This output is routed to supervision lamp board PC2 via an inverter and lamp driver. It is also routed to the DISPLAY FUNCTION switch via a buffer and inverter on card 10.

4.20 When M dial pulse signaling is monitored, a train of positive-going pulses appears at the M output of the level detector. This output is routed to supervision lamp board PC2 via a lamp driver on card 9. It is also routed to the DISPLAY FUNCTION switch via a buffer stage on card 10. The DISPLAY FUNCTION switch selects the desired E or M signal to appear at the input of the 60ms off-hook timer, on-hook timer, and pulse width comparator.

4.21 The signaling is now processed the same way as loop dial pulse signaling described in paragraphs 4.11 through 4.15.

## 4.22 MF SIGNAL PROCESSING WITH LOOP SUPERVISION.

4.23 In this mode of operation (figure 4–4), DISPLAY FUNCTION switch S1 provides the control bias voltage for the FET transmission gate on

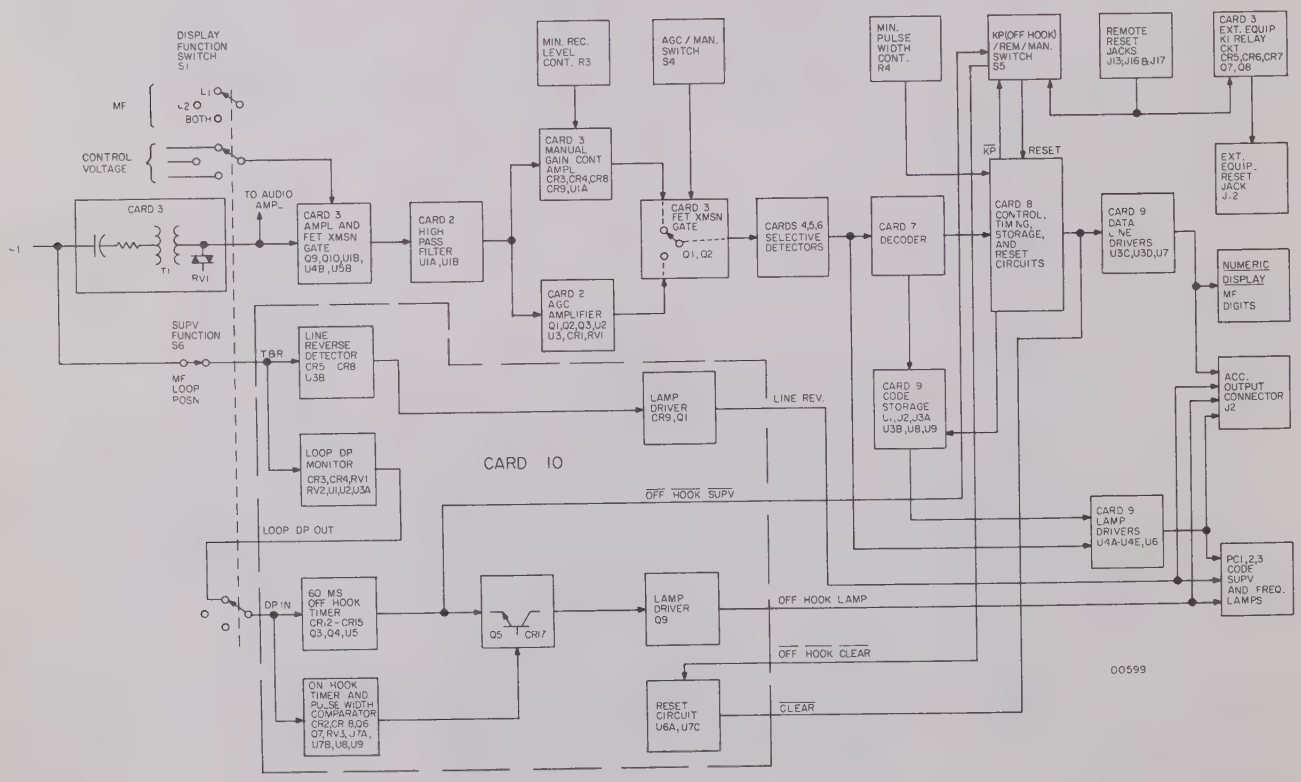



**Figure 4–4. TTS 2762, MF Signal Processing with Loop Supervision, Block Diagram**

card 3, and a signal path from the loop DP monitor output to the 60ms off-hook timer and pulse width comparator on card 10.

4.24 The MF signaling to be displayed is on the $L_1$ input. Here, the signal is routed to two points for processing: (1) a balanced, high-impedance input from which it will be routed to the audio reproduction circuits and MF decoding circuits for display, and (2) the line reversal and dial pulse off-hook/on-hook detectors via SUPV FUNCTION switch S6 for detecting and displaying loop supervision.

4.25 The MF signaling to be processed for display is routed through a transmission gate, controlled by the DISPLAY FUNCTION switch, to a high-pass filter. The filter removes the power line interference from the signaling. The signaling is then processed through an automatic gain control (AGC) on card 2 and a manual gain control amplifier on card 3. MIN REC LEVEL control R3 provides the biasing to set the minimum signal level to be processed by the manual control amplifier. A second transmission gate, controlled by AGC/MAN switch S4, selects either the AGC or manual gain control output. The selected output is routed to six selective detectors that incorporate threshold detectors. The selective detective will determine which frequencies in the MF signaling are present and, if the level is high enough, will trigger their respective threshold detectors.

4.26 At this point, the analog processing of the signaling is ended. A logic 1 (high) from the detectors will indicate the frequencies in the MF signaling.

4.27 The detector outputs drive frequency lamps on PC3 via the lamp driver on card 9. They are also routed to a 2 and only 2 out of 6 decoder matrix that converts them to a BCD format to be compatible with the numeric display.

4.28 The decoded MF digit signals are then timed, gated into temporary storage, and routed through appropriate drivers on card 9 to numeric display and accessory output connector J2. MF digits are inhibited unless KP or other reset commands have been received since the last ST code.

4.29 MF codes are routed from the decoder to temporary storage and lamp drivers on card 9, then to code lamp board PC1 for display and ACC Output connector J2.

4.30 LOOP SUPERVISION is monitored via SUPV FUNCTION switch S6, by the line reversal detector and the loop dial pulse monitor. If a tip-ring reversal appears on $L_1$, the LINE REVERSE lamp on PC2 will be extinguished by its associated lamp driver (CR9,Q1).

4.31 An off-hook condition on $L_1$ will cause the loop dial pulse monitor output to go high. This output is then routed through DISPLAY FUNCTION switch S1 to the 60ms off-hook timer, the on-hook timer, and the pulse-width comparator.

4.32 Since the input to the pulse-width comparator is a steady-state high during an off-hook condition, the comparator output remains in a quiescent state that keeps Q5 switched on.

4.33 The 60ms off-hook timer output goes low during an off-hook condition. This provides a supervision clear pulse to the numeric display (with or without KP code) via the reset switch (KP (OFF HOOK) position), reset circuit on card 10, and a driver on card 9. The output from the 60ms off-hook timer also provides a current sink for Q5. This in turn extinguishes the OFF-HOOK lamp on PC2 via the output of lamp driver Q9.

4.34 Other than the reset command initiated by an on-hook/off-hook transition, the RESET switch enables the reset cycle to be triggered by a KP pulse, a remote reset input, or by a manual switch operation.

### 4.35 MF SIGNAL PROCESSING WITH E&M SUPERVISION.

4.36 The DISPLAY FUNCTION switch is used to select $L_1$, $L_2$, or both inputs by providing the appropriate control bias voltage to the FET transmission gate on card 3.

4.37 Referring to figure 4–5, Block Diagram of MF Signal Processing with E&M Supervision, it is seen that the MF signaling can be received on both $L_1$ and $L_2$ inputs to be selected for processing. The process of interpreting and displaying the frequency, code, and numeric content of the MF signaling is identical to that described in paragraphs 4.25 through 4.29.

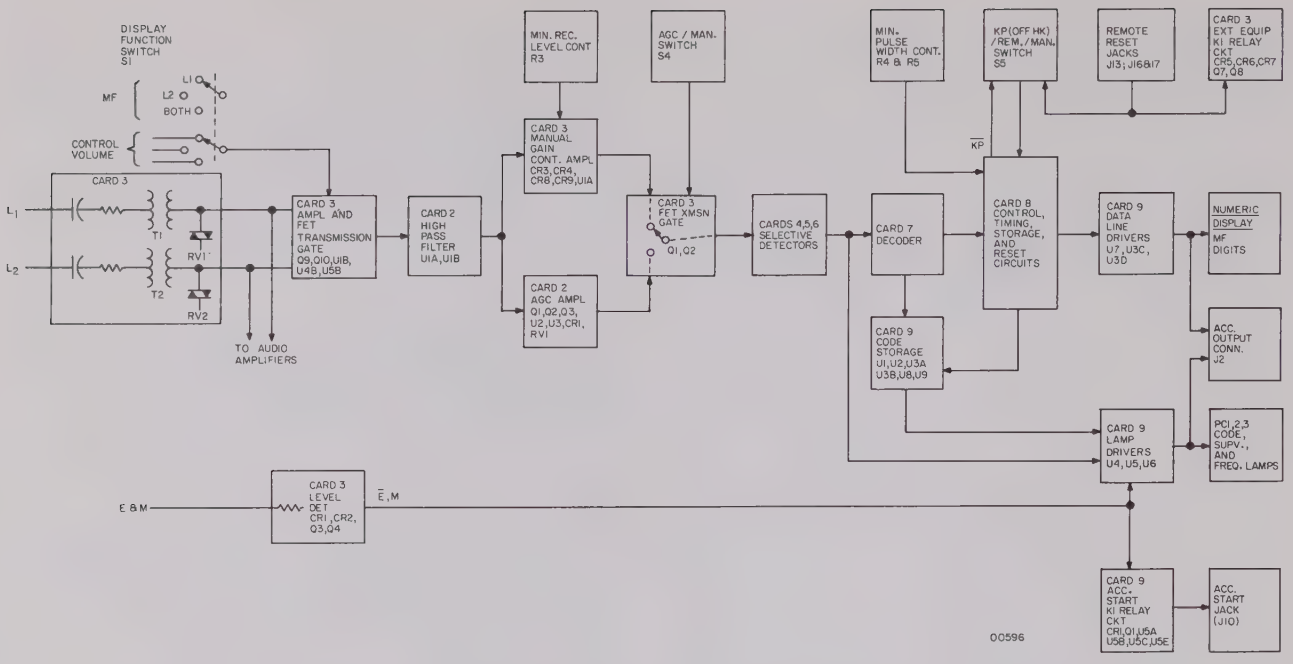

DISPLAY FUNCTION SWITCH S1
MF
L1
L2
BOTH
CONTROL VOLUME
CARD 3
L1
L2
T1
T2
RV1
RV2
TO AUDIO AMPLIFIERS
CARD 3 AMPL AND FET TRANSMISSION GATE Q9,Q10,U1B, U4B,U5B
CARD 2 HIGH PASS FILTER U1A,U1B
MIN. REC. LEVEL CONT R3
CARD 3 MANUAL GAIN CONT. AMPL CR3,CR4, CR8,CR9,U1A
CARD 2 AGC AMPL Q1,Q2,Q3, U2,U3,CR1, RV1
AGC / MAN. SWITCH S4
CARD 3 FET XMSN GATE Q1,Q2
CARDS 4,5,6 SELECTIVE DETECTORS
MIN. PULSE WIDTH CONT. R4 & R5
CARD 7 DECODER
KP(OFF HK) /REM./MAN. SWITCH S5
KP
CARD 8 CONTROL, TIMING, STORAGE, AND RESET CIRCUITS
REMOTE RESET JACKS J13; J16&17
CARD 3 EXT EQUIP K1 RELAY CKT CR5,CR6,CR7 Q7,Q8
CARD 9 DATA LINE DRIVERS U7,U3C, U3D
NUMERIC DISPLAY MF DIGITS
ACC. OUTPUT CONN. J2
CARD 9 CODE STORAGE U1,U2,U3A U3B,U8,U9
CARD 9 LAMP DRIVERS U4,U5,U6
PC1,2,3 CODE, SUPV., AND FREQ. LAMPS
E & M
CARD 3 LEVEL DET CR1, CR2, Q3,Q4
E,M
CARD 9 ACC. START K1 RELAY CKT CR1,Q1,U5A U5B,U5C,U5E
ACC. START JACK (J10)
00596

**Figure 4–5. TTS 2762, MF Signal Processing with E and M Supervision, Block Diagram.**

4.38 E&M supervision is accomplished by monitoring the E&M leads with two separate dc-coupled level-detector circuits. The detectors monitor the E lead for ground and the M lead for an open or central office battery. Their outputs (E,M) are routed to the lamp drivers and relay circuit on card 9. The drivers extinguish the appropriate lamp(s) (E,M) on PC2. The relay circuit will release the K1 relay and provide a contact closure for operating accessory equipment via ACC START jack J10. The contacts will remain closed until both E and M leads indicate an on-hook condition.

4.39 DETAILED CIRCUIT DESCRIPTION.

4.40 Paragraphs 4.42 through 4.109 provide the detailed circuit description of cards 2 through 11, and PC1 through PC4. All descriptions are in reference to their respective schematic diagrams located in section 7 of this manual.

4.41 A better understanding of the circuit functions in relation to the whole unit can be obtained by cross-reference to the overall schematic diagram in section 7, and the block diagrams discussed in the preceeding text of this section.

4.42 MF INPUT (AGC) (CARD 2).

4.43 The functions of the AGC Board are twofold: to subject input signals to a high-pass filter and to provide a relatively stable output level for the bandpass filters on cards 4,5, and 6 for any input level within a 30 dB dynamic range.

4.44 Refer to the schematic diagram in figure 7–3. Integrated circuit U1 provides a four-pole, active high-pass, filter with an in-band gain of approximately 0 dB for suppression of power line interference and harmonics. The cutoff frequency is approximately 380 Hz.

4.45 The output of the high-pass filter is routed to a manual gain control (MGC), on card 3, and to the AGC of card 2. Choice of MGC or AGC is made by means of the front panel MAN/AGC switch S4, which controls a transmission gate on card 3.

4.46 The AGC circuit maintains nearly constant output amplitude over approximately 30 dB of input signal variation. This provides the filters and detectors on cards 4,5, and 6 with nearly constant input, maintaining their characteristics over the full dynamic range of the unit.

4.47 AGC is achieved by varying the feedback path around U2A with the drain-source resistance

of Q1. With no signal present, Q1 is turned on through R16. Its low drain-source resistance and R14 form an attenuator that reduces any ac feedback to pin 2 of U2A by approximately 30 dB. Any signal received is amplified at full gain and coupled through C8 to two of the four inputs of U3. If the signal peaks exceed the offset voltages set up by divider chain R21,R23,R25,R27 and R28, the normally off sections of the two differential amplifiers in U3 will conduct; one on the positive peak and one on the negative peak. Since both conduct through R18, a greatly amplified full wave negative going signal appears across R18. The gate of Q1 is rapidly pulled negative increasing the channel resistance and decreasing the gain of the stage.

4.48 The circuit reaches a steady state within two or three cycles of signal at such an output level that the amplified peaks just exceed the offset voltages set by the divider. The circuit returns to its original state over a much longer time (hundreds of milliseconds) controlled by R16 and C7.

4.49 A normally open FET switch is used to block idle line transients and initial surges caused by high level signals from the filters. The incoming signal amplitude must be sufficient to drive the gate voltage of Q1 more negative than an adjustable reference voltage set by R33 before the switch will close. Resistors R31 and R32 provide a slight positive feedback around comparator U2B to prevent switch chatter. Thus in addition to blocking initial transients, the circuit establishes a fairly precise threshold below which signals will not be processed.

### 4.50 SELECTIVE DETECTORS (CARDS 4,5, and 6).

4.51 The amplified MF signal from card 3 (MF Out) has a level of approximately −27 dBm. It is routed to six parallel-connected, selective detectors located on cards 4,5, and 6. As shown on figure 7−5, each selective detector card consists of two stagger-tuned, 4-pole active bandpass filters U1A,U1B and U3A,U3B followed by threshold detectors U2A, U2B and U4A,U4B, respectively.

4.52 Consider the circuit consisting of U1 and U2 (cards 4,5,and 6). The resonant frequency of each section of the filter (U1A,U1B), connected by a strap from pin 5 to pin E, is determined by the Wien-type network associated with it. For U1A, the network is R8,R9,R10,C2, and C3. The Q of this section is controlled by feedback network R5,R6, and R7. The fraction of the filter output routed to threshold detector U2, and thus the input level at which the detector will trip, is set by R18. The detector circuit is basically a feedback full-wave bridge consisting of U2A,CR1,CR2,C7,C8,R19, R20, and C6 with a fixed dc offset established by R21 and R24. When the average value of the full-wave rectified signal exceeds the offset voltage the output of U2B goes from low to high and drives Q1 on and Q2 off. Transistors Q1 and Q2 allow direct interface with logic circuits on the decoder card 7.

### 4.53 MAIN INPUT (CARD 3).

4.54 The main input board provides the following:

a. Two high-impedance, balanced, dc-blocked inputs for Line 1 and Line 2.

b. Circuitry for MF channel selection.

c. Speaker driver and volume controls (along with front panel controls) for $L_1$ and $L_2$.

d. High input-impedance level detector for the E&M inputs.

e. Manual gain control circuitry for MF signals.

f. External equipment reset feature.

4.55 As shown on schematic diagram figure 7−4, T1,R28,C11, and T2,R20,C12 provide two independent, high-impedance, balanced, dc-blocked input channels for bridging and monitoring MF signalling or audio range sound reproductions via speaker and AUDIO ACC jack J11. Varistors RV1 and RV2 provide transient protection in the transformer secondaries.

4.56 Ic's U1B and U4B provide MF signal isolation between input channels $L_1$ and $L_2$. According to the position of DISPLAY FUNCTION switch S1, transmission gate Q9 and Q10 switches through to U5B, signals from either or both input channels. U5B and R51 provide for 0 dB gain from RV1 to test point 3.

4.57 Signals from the $L_1$ and $L_2$ inputs are also

routed through separate high-pass filters to identical audio amplifiers, attenuated by $L_1$ and $L_2$ VOLUME controls R1 and R2, summed, and amplified again by the audio output amplifier. The combined audio is fed to the speaker, speaker switch, and, by twisted pair, to AUDIO ACC jack J11.

4.58 The E&M inputs provide high-impedance level detectors to monitor and interpret E&M (line and drop) conditions. The E level detector reflects an on-hook condition for an input voltage more negative than approximately –9.9 Vdc, or when the input is open. When a ground or a dc voltage more positive than –9.9V is applied to the input, Q3 switches on: the output lead enables the drivers on card 9 for the E lamp and the accessory start feature (the instrument defines this input as an E off-hook condition); if DISPLAY FUNCTION switch S1 is in the E DP position, the E level detector output is also connected to the T–R/E/M DC Input card (card 10) for off-hook lamp operation and dial pulse counting, timing, and display.

4.59 The M level detector reflects an on-hook condition for input voltages more positive than approximately –22.6 Vdc, or when the input is open. When central office battery or a dc voltage more negative than approximately 23V is applied to the input, Q4 switches off; the output lead enables the drivers on card 9 for the M lamp and the accessory start feature, (the instrument defines the input as an M off-hook condition); if DISPLAY FUNCTION switch S1 is in the M DP position, the M level detector output is also connected to the T–R/E/M DC Input Card (card 10) for off-hook lamp operation and dial pulse counting, timing, and display.

4.60 The E lead corresponds to drop and is connected to both J8 tip and J9 tip. The M lead corresponds to line and is connected both to J8 ring and J9 ring.

4.61 The MF input singals to $L_1$ and $L_2$ pass from card 3 through pin C to the high-pass filters on card 2. After being filtered the signal appears at the input of the AGC and, via pin 6 (MF HP Out) on card 2 to the input of the manual gain amplifier on card 3. Both the AGC and the manual gain control circuit outputs are routed to transmission gate FETs (Q1 and Q2) for selection.

4.62 If MAN/AGC switch S4 is in the AGC position, then a +12 V dc signal is applied to the gates of transmission gate FETs Q1 and Q2. This switches the AGC output of card 2 through to pin 5 (MF Out) card 3, and to the selective detectors.

4.63 If the MAN/AGC switch is in the MAN position, then a –12 Vdc signal is applied to the gates of transmission gate FETs Q1 and Q2. This switches the manual gain control circuit output to pin 5 (MF Out) and to the selective detectors.

4.64 The manual gain control circuit employs current-control of diode resistance in the input and feedback path of amplifier U1A. If the Manual Gain Control input voltage is 0, both diodes CR3 and CR4 are reverse biased and the stage gain is unity. If the Manual Gain Control input voltage goes positive, CR4 is reverse biased but CR3 conducts. The dynamic resistance of CR3 and resistor R4 form an attenuator that reduces the feedback signal to pin 2 of U1A by up to 10 dB, thus increasing stage gain by up to 10 dB. If the Manual Gain Control input voltage goes negative CR3 is reverse biased but CR4 conducts, decreasing the input signal amplitude and stage gain by up to 10 dB.

4.65 The REMOTE RESET input and the manual contact of the RESET switch are routed directly to the external equipment relay driver via pin 22 (Remote Reset). This energizes K1 to provide an isolated contact closure to reset accessory equipment (TN 76 for example) whenever the TTS 2762 receives a remote reset command or manual reset.

4.66 MF DECODER (CARD 7).

4.67 The MF Decoder scans the six outputs of the selective detectors on cards 4,5, and 6 and decodes these TTL signals to one of the five codes or ten digits recognized by the TTS 2762.

4.68 Two, and only two of six frequencies are required for an MF code or digit (See tabel 3–4). When only one, or more than two, frequencies are simultaneously present, then no logical output is generated by card 7.

4.69 The outputs shown on figure 7–6 include negative logic forms of the MF codes: KP/KP1, ST, KP2/ST2P, CD11/ST3P, and CD12/STP. These outputs are directly routed to card 9 to await a lamp strobe signal from card 8 to enable lamp activation.

4.70 The MF digits are decoded directly to a BCD format and routed to card 8 for gating to the numeric display after a timing check.

4.71 Other signal outputs include a positive logic KP, ST, and a CD11 + CD12 to perform various functions on the register circuitry of card 8.

4.72 The $\overline{CLK}$ output of card 7 provides a logical zero signal for the duration of any legitimate MF code or digit. This pulse interval is compared on the register card to the setting of the MIN PULSE WIDTH control and rejected, if shorter.

## 4.73 REGISTER CARD (CARD 8).

4.74 The functions of the register card are limited to MF operations and include: timing of input data pulse widths compared to the setting of the MIN PULSE WIDTH control; reset command detection, timing, and conversion; an instrument latch caused by ST signals; temporary storage of digit data in BCD format; and a data present pulse generator for the numeric display.

4.75 Typical circuit waveforms for data inputs are indicated by a circled letter, on figure 4–6, and referenced to the register schematic, figure 7–7.

4.76 All signals decoded by card 7, the MF decoder, cause the appearance of a $\overline{CLK}$ pulse Ⓐ on pin 19 of the register card. This lasts for the duration of the signal. The leading edge of the $\overline{CLK}$ pulse allows pulse width timer circuits U7A and U7B to start timing by inhibiting U7B; allowing capacitor C3 to charge from ground toward +12 volts at a rate determined by the setting of the MIN PULSE WIDTH control. Schmitt trigger U7A switches when and if C3 reaches approximately six volts before the end of the $\overline{CLK}$ pulse. The leading edge of the transition inhibits U7C momentarily, producing a ten microsecond positive pulse Latch Clock pulse Ⓑ. The trailing edge inhibits U7D, which produces a seven microsecond positive pulse (KP clock Ⓒ). The trailing edge of the KP clock pulse inhibits Q6 and produces a six microsecond positive pulse Lamp Strobe pulse Ⓓ.

4.77 As shown on figure 4–6, four of the five $\overline{CLK}$ pulses longer than the MIN PULSE CONTROL setting of 60 milliseconds cause the generation of three pulses as previously described (Latch Clock Ⓑ, KP Clock Ⓒ, and Lamp Strobe Ⓓ).

4.78 The trailing edge of Latch Clock pulse Ⓑ causes JK flip flop U2 to transfer and hold an ST signal on its Q output Ⓔ, disabling U3 and preventing generation of data present pulses through U4A and U4B. Output Ⓔ remains high until reception of a reset command.

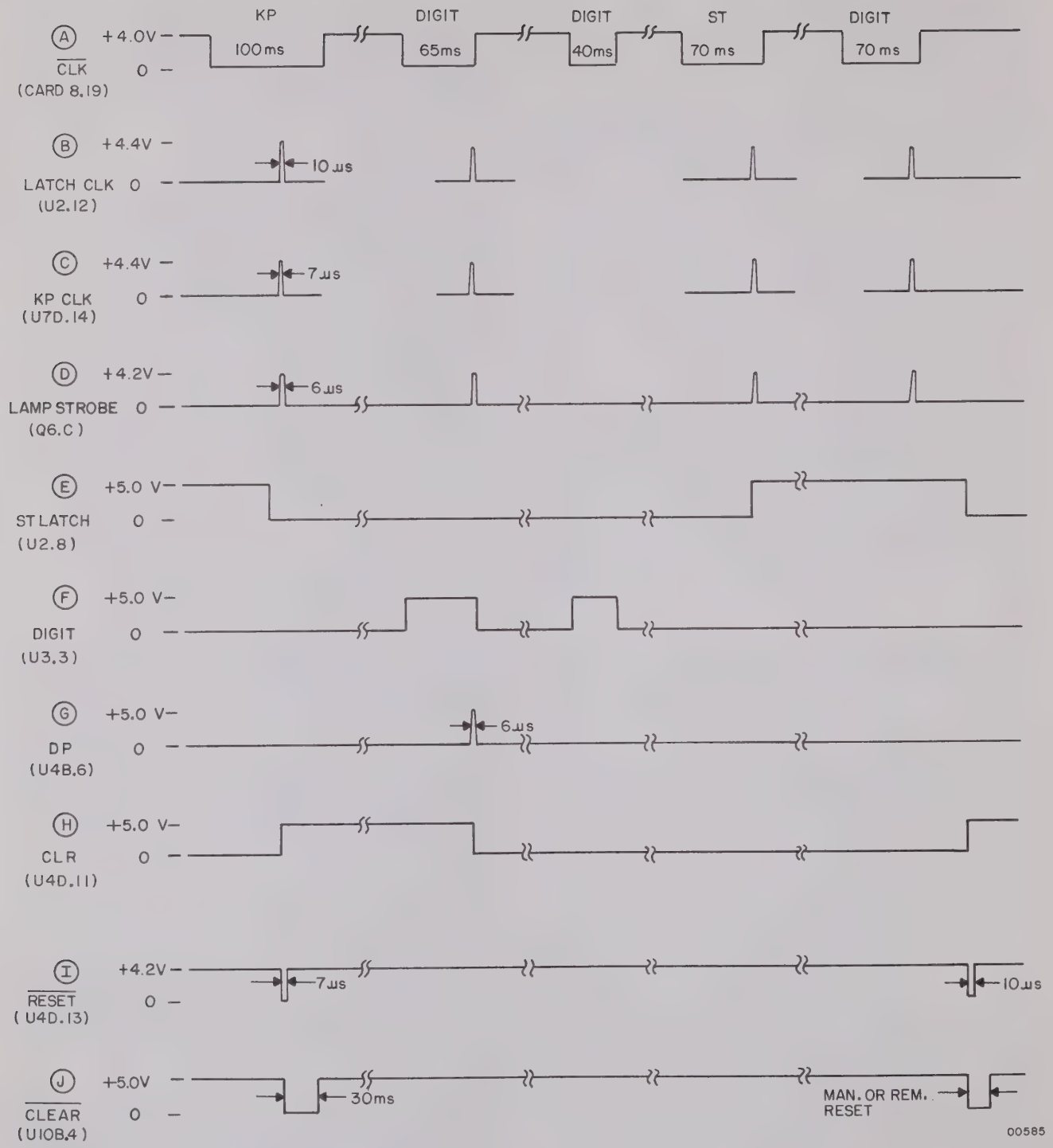
4.79 KP clock pulse Ⓒ enables one input of the discrete three-input NAND gate (Q11,Q12,Q13). If the Reset switch is in the KP (OFF HOOK) position, the second input (Q13) is high; the simultaneous reception of a KP signal will enable the third input and the normally high reset line Ⓘ will be pulled low. This will perform the following functions: KP latch U2 will be cleared (its Q output Ⓔ returned to logic 0); clear flip flop U4C and U4D Ⓗ will be reset causing the generation of a 30ms $\overline{CLEAR}$ pulse for the numeric display through U9B and U10B Ⓙ; the lamps will be reset through pin 14 (Lamp Reset) and card 9; and D flip flops U5 and U6 will be cleared of any digital data.

4.80 Lamp Strobe pulse Ⓓ performs three functions: enables the lamp drivers of card 9 should any MF code be present; generates a data present pulse through U4A and U4B Ⓖ (with the simultaneous presence of a signal from U3 Ⓕ of a digit present pulse) which clocks digital D flip flops U5 and U6, gates their outputs for 25 milliseconds through U8 and U9A, and generates a $\overline{DATA\ PRESENT}$ pulse through U10A to clock the numeric display; and sets clear flip flop U4C and U4D Ⓗ when a digit present pulse is also present to permit subsequent generation of a display $\overline{CLEAR}$ signal.

4.81 U1 acts as a timer for reset commands Ⓙ (OFF HOOK), MAN or REM); those commands longer than approximately 11 milliseconds permit C1 to discharge to a level at which U1A will be switched off, and a reset pulse Ⓘ of approximately 10 milliseconds duration will have the same effects as a KP derived reset command described in paragraph 4.79.

4.82 U9 and U10 are open collector devices having pullup resistors on card 9. Their outputs are connected in parallel with similar gates on card 10 to allow the BCD, data present, and clear signals for numeric display to be transmitted from either MF gates U9 and U10 on card 8, or dial pulse gates on card 10.

## 4.83 BUFFER (CARD 9).




CONDITIONS:

A. DISPLAY FUNCTION SWITCH (S1) – MF $L_1$

B. MIN. PULSE WIDTH CONTROL (R4 + R5) – 60ms

C. RESET SWITCH (S5) – KP (OFF HK)

**Figure 4–6. TTS 2762. Register Waveform and Timing Diagram**

4.84 The Buffer card performs five main functions: provides current sinks for thirteen of the fifteen light-emitting diodes on PC1,PC2, and PC3 upon commands from cards 7,8, and 10; accepts from card 8 or card 10, and transmits to numeric display, BCD, data present, and clear information; latches any of the five code lamps until reception of a reset command; provides the accessory start feature; and also provides nineteen of the twenty-three outputs of the accessory connector, J2.

4.85 Referring to the schematic diagram, figure 7–8, RS flip flops U1,U2, and U3A,U3B are set by simultaneous code signals from card 7 and a lamp strobe signal from card 8, to gate U8 and U9. Reset of all latches is accomplished by a signal on pin K (LAMP RESET, from card 8.

4.86 When either or both the E and M inputs are in an off-hook condition, Q1 is switched on and K1 is energized providing a dry contact closure rated at 115 V, 2 amperes to START ACC jack J10 on the front panel.

4.87 Nineteen of the twenty-one outputs (excluding the Accessory Start outputs) are connected to Accessory Connector J2 as well as the LEDs and numeric display. These outputs, together with the other four pins of J2 (OFF HOOK, LINE REV, ground, and remote reset) can drive two TTL loads.

4.88 **T–R/E/M DC INPUT (CARD 10).**

4.89 The functions of the DC Input card include: detection for display of loop supervision conditions; detection for display of line polarity (LINE REV); timing circuits for on-hook,off-hook, and inter-digit intervals; pulse-width comparison to external control; dial-pulse counting; and, for the numeric display, BCD, reset, and data present pulse command generators.

4.90 Loop Dial Pulse Observations. When the DISPLAY FUNCTION switch is in the DP $L_1$, DP $L_2$, or MF $L_1$ positions, (with the SUPV FUNCTION switch in the MF LOOP position), the proper input is connected directly to the TIP and RING pin (2&4/D) of card 10 as well as the audio amplffier on card 3. U1A and U2A are level detectors whose outputs are negative when their respective inputs are more negative than approximately –5Vdc. U1B and U2B invert those input signals that have durations longer than approximately 4 milliseconds. The AND gate formed by CR3,CR4,R7,R9, and U3A produces high outputs (off-hook) when both tip and ring inputs are negative.

4.91 Line Reversal Detector. U3B is a diode-protected pre-biased level detector whose output remains high for no input or for tip voltage level more negative than ring voltage levels. When a line is reversed ($V_{tip}$ more positive than $V_{ring}$), U3B inhibits lamp driver Q1, extinguishing the LINE REV lamp.

4.92 E&M DP Observations. The E&M level detector on card 3 is directly connected to lamp and relay drivers on card 9, to the E input (pin 7/H), and to the M input (pin 8/J) of card 10. The E signal is inverted by integrator U4A for those transients lasting longer than approximately one millisecond. The M signal is inverted by Q2 and again by integrator U4B if the transition is longer than one millisecond. The E and M outputs are both high (+5 Vdc) for off-hook conditions and low (–5Vdc) for on-hook.

4.93 Dial Pulse Input. Dial Pulse Input lead pin 11/M is connected to the E,M, or loop DP outputs on card 10, depending on the position of the DISPLAY FUNCTION switch. This input is routed to three parallel circuits: an off-hook timer; an on-hook timer; and a two transistor stage gate that converts the DP input signals from ±5 Vdc to TTL levels (+5 Vdc and ground) for comparison with the pulse width comparator output.

4.94 Off-Hook Timer. The Dial Pulse Input waveforms approximate rectangular pulses switching from approximately +5Vdc to –5Vdc; the positive voltage is representable of off-hook and the negative, on-hook. Differential amplifier U5D and U5C ignores any high (off-hook) signal from the Dial Pulse Input whose duration is less than approximately 60ms. A high input on pin 12 of U5D enables a charge path through U5 to C5, charging that capacitor toward +12Vdc. If the high input signal lasts longer than 60ms, the voltage at pin 14 ramps down to approximately 0.9Vdc forward biasing CR12 and setting a flip flop. This RS flip flop, composed of Schmitt trigger U5A and output Q4, switches one input of discrete NAND gate U5B,Q5,Q9, which indirectly drives the OFF HOOK lamp. Forward biasing of CR12 causes the differential amplifier output (U5A, pin 1 and 5) to change state. The collector current from U5A, pin 5, creates a voltage drop

across R32 forward biasing Q4. Also, C6 is charged to approximately +3 Vdc through R31 to maintain a constant output at Q4 until the On Hook Timer resets the flip flop via CR16.

4.95 On Hook Timer. Differential amplifier U7A presents an output that is compared to an external on-hook interval timing control through U8; this output is also the Off-Hook flip flop reset signal, if the on-hook (low) duration of the DP Input signal exceeds approximately 210ms. The off-hook transition (low to high) of the DP Input causes a current flow through pin 1, creating a drop across R43 and switching on Q6. Capacitor C10 imparts a small (approximately 6ms) transitional delay to compensate for the slew rates of U8A and U8B. Capacitor C11 is quickly discharged through R45. An on-hook transition (high to low) reverses the operation except that the rate at which C11 is charged much slower. If the on-hook signal (low) lasts longer than approximately 210ms, the output voltage is allowed to ramp downward toward a level that will reset off-hook flip flop U5A and Q4, disabling NAND gate U5B,Q5, and Q9.

4.96 Pulse Width Comparator. U8A and U8B comprise a level detector that compares the ramp output voltage of the On-Hook Timer to preset voltage levels (window) for passage, or rejection, of a given pulse. The window is formed by one input (U8B.6) preset to +6 Vdc and one input (U8B.3) that can be set in a range anywhere from +7.4 Vdc to +11.2 Vdc by the MIN PULSE WIDTH control (100ms to 18ms, respectively).

4.97 For example: If the MIN PULSE WIDTH control is set at 65ms, a level of approximately +8.9Vdc would appear at pin 3 of U8A. A voltage (+12 Vdc) will appear at pin 2 and 5 of U8 and begin to decay 6 milliseconds after reception of an on-hook (low) signal. The voltage decay will form a ramp which, if the on hook signal duration is greater than 65 milliseconds, will reach the upper window limit (+8.9 Vdc), causing both outputs of U8 to go high. Test point TP1 will now be at a logic 1 level (approximately +4.5 Vdc). The ramp function will continue downward until the end of the on-hook signal or a level of approximatley +0.9 Vdc is reached, at which time the off-hook flip flop will be reset as described above. If the ramp passes through the lower window limit (+6 Vdc), in this case, approximaetly 60ms after the upper limit was reached, the output of U8B will switch to a low-level and terminate the logic 1 signal at TP1. Should an on-hook duration be less than the MIN PULSE WIDTH control setting, the ramp is never allowed to reach the upper limit of the window, and is reset to +12 Vdc.

4.98 Legitimate Dial Pulse Collation. U9 performs three functions: compares the Dial Pulse Input signal (after conversion to TTL levels,) Pulse Width Comparator U8 output at TP1, and the output of the off-hook flip flop; passes legitimate pulses forward to the counter; and drives the second output of the off-hook NAND gate. The Pulse Width Comparator generates output whenever the ramp output of U7A passes through the prescribed window. This includes initial on-hook/off-hook and final off-hook/on-hook transitions as well as pulses of legitimate length. Referring to figure 4—7, the first on-hook/off-hook transition does not change the output of U9B because the off-hook status at the output of U5B continues to disable U9B for 60ms after the transition. The final off-hook/on-hook transition is ignored because TTL converter U7B and Q7 tracks the Dial Pulse Input, inhibiting U9B via pin 3.

4.99 Off Hook NAND Gate. The second function of U9 is to disable one input of NAND gate U5B,Q5 and Q9 after the occurance of legitimate length dial pulses. When CR17 is forward biased Q5 is inhibited and Q9 enabled, causing the OFF HOOK lamp to indicate an on-hook condition.

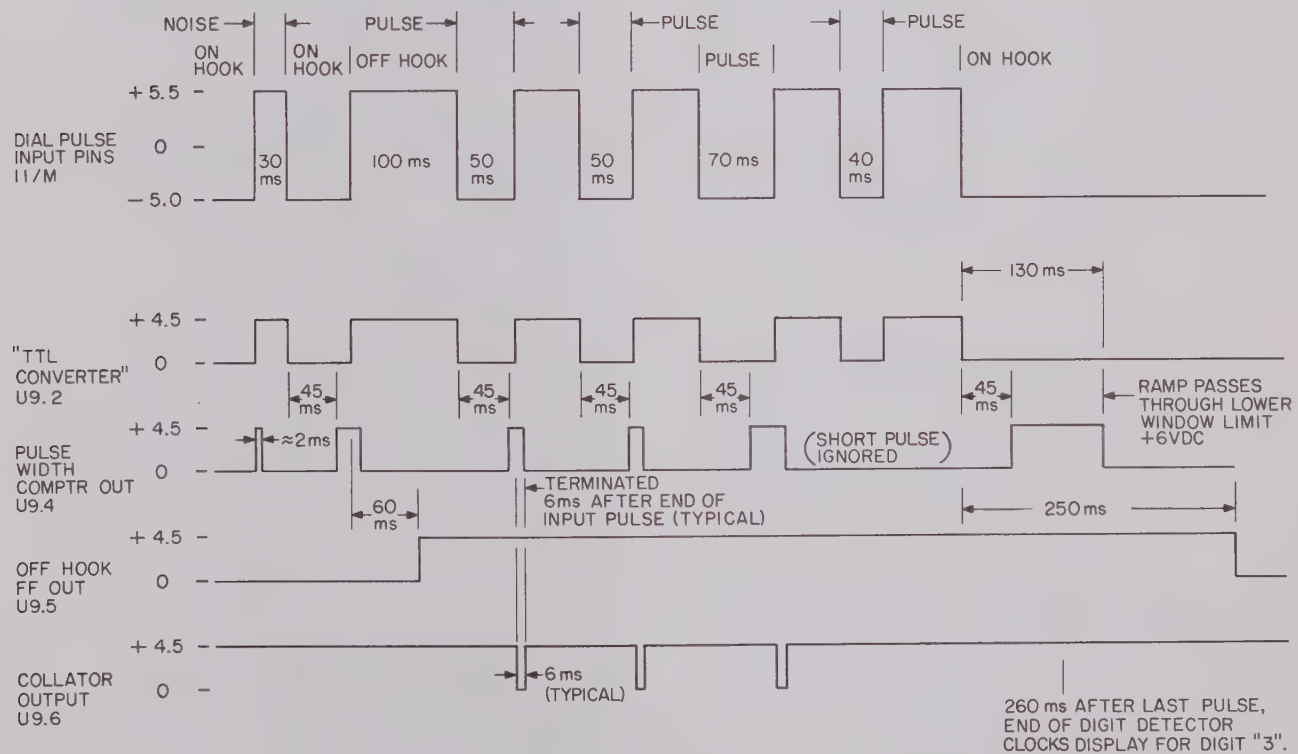
4.100 Clear Pulse Generator. Off-hook flip flop U5A and Q4 enables U5B after an off-hook condition has been received and verified for proper length. The collector of U5B is connected to the input of U6A when the RESET switch is in the KP (OFF HOOK) position. This negative transition signals U6A to generate a 30ms pulse that is inverted by U7C and passed through gates on cards 8 and 9, clearing the numeric and code lamp displays. U6A is, by specification, triggered only upon reception of a 60ms off-hook signal that has been preceded by a 210ms on-hook interval.

4.101 Dial Pulse Counting. Interdigital Timing and Control. U10 receives a train of pulses for each digit from U9C and provides the total at its BCD outputs. Transient protection for U10 is provided by several means: R60 and C14; gating of the End of Digit input; and gating of BCD output U14. The first

count releases the latch on the End of Digit Detector input via U11A and U13B. The leading edge of this, or any subsequent pulse, that represents the on-hook condition, eliminates the charge on C15. If the on-hook condition lasts longer than approximately 260 milliseconds, C15 will charge, through R63, to a high enough level to trigger U13A of the End of Digit Detector. This is the timing that the End of Digit Detector uses to indicate that full count for the current digit has been received. The detector proceeds to initiate a chain of events. U13D is enabled and, through U12C, gates the BCD output, through U14, to card 9, from which the numeric display is directly driven. Should the dial pulse count be ten, then U12B detects this condition and disables U14, but not Data Present Pulse Generator U6B and U13C. The numeric display regards the lack of output from U14, coincident with a data present pulse, to be the digit 0 and displays it as such.

4.102 Data Present Generator. Other commands of the End of Digit Detector are implemented through U6B. A 25ms one-shot is inverted by U13C and passed through gates, on card 9, to the numeric display. Counter U10 is reset to zero by a 1 millisecond pulse provided by Q8 at the trailing edge of the one-shot pulse. When the count is reset to zero U12A is disabled through U11A and U13B, which in turn disables U14 until the next sequence of pulses.

4.103 Open Collector Operation: BCD Data, Clear, and Data Present Commands. Clear command output U7C, Data Present output U13C, and Data outputs of U14, are open collector devices wired in parallel with similar drivers on MF Register card 8, and in series with display driving gates with pull-up resistors on card 9. This wire AND design permits simultaneous use of the numeric display drivers of Card 9 from the MF-sourced data of card 8 and the DP-sourced data of card 10.




NOTES:

1. MIN. PULSE WIDTH CONTROL SET AT 45 ms.
2. SEQUENCE OF INPUT: 30ms FALSE OFF HOOK; 100ms OFF HOOK; DIGIT "4"; ON HOOK.

00600

**Figure 4–7. TTS 2762, Dial Pulse Collator Timing Diagram**

### 4.104 INTERCONNECTION CARD 11.

4.105 Card 11 performs three functions: mounting for, and approximately ninety interconnections among, cards 1 through 10; provides access to the power transformer and power transistors through J20 and also, through J1, to over fifty external connections to various controls, displays, and other outputs on J2 and on the front panel; and provides current limiting for the remote reset circuitry on various boards should a voltage considerably higher than TTL levels be applied to the Remote Reset jacks. Diodes CR1 and CR2 limit the logic input voltage, while F1 limits the input current to 0.125 amps.

### 4.106 CODE,SUPERVISION,AND FREQUENCY LAMP BOARDS (PC1,2, and 3).

4.107 These three boards consist entirely of light emitting diodes that have their anodes connected to +5 Vdc, and each of their cathodes brought out through 100-ohm current limiting resistors to lugs. Card 9 provides current sink drivers for all lamps on PC1, PC3 and the E and M lamps on PC2. Card 10 provides the drivers for the OFF HOOK and LINE REV lamps of PC2. The frequency and code lamps of PC1 and PC3 operate by positive logic. i.e., frequency or code present equals lamp on. The supervision lamps of PC2, however, operate by negative logic. A lit lamp indicates an idle condition (no connection or on-hook; no connection or line not reversed).

### 4.108 TERMINATION BOARD (PC4).

4.109 The Termination Board provides access between the numeric display and cards 9 and 11. Six of the inputs, form card 9, are positive TTL logic BCD data for the numeric display, negative logic data present, and clear pulses. These six leads are also provided pull-down resistors to protect the circuitry of the numeric display.

**WARNING**

**Do not remove the termination board from the numeric display without first mounting the metal shorting clip over the fingers of the lower display board. The remaining four leads are −12Vdc, +5Vdc, +250 Vdc, and ground connections. The three volatge leads are provided with additional filtering on the Termination Board to protect the numeric display.**

# MAINTENANCE AND CALIBRATION

## 5.1 INTRODUCTION.

5.2 The TTS 2762 and TTS 2762R do not require preventive maintenance. This section, therefore, provides only the information and instructions necessary to perform corrective maintenance, which involves a performance check; troubleshooting; and calibration of the set - unless otherwise noted, the information and instructions apply to the TTS 2762R as well as the TTS 2762. Sections 3 and 4 of this manual provides the theory of operation and circuit theory, respectively, that serves as indispensable supplements to facilitate troubleshooting.

NOTE

**Prior to calibartion, it is advisable that the factory be contacted for technical assistance.**

## 5.3 SERVICE INFORMATION.

5.4 Each instrument manufactured by Northeast Electronics Corporation is warranted for a period of one year upon delivery to the original purchaser. Complete warranty information is located on the rear of the title page of this manual. Note that written authorization is required prior to the return of any equipment for factory repairs. Additional service information can be obtained by contacting Northeast Electronics Corporation, Customer Service Department, P.O. Box 649, Concord, New Hampshire, 03301, telephone number 603–224–6521.

## 5.5 TEST EQUIPMENT.

5.6 Equipment recommended for testing, troubleshooting, and calibration of the TTS 2762, together with the minimum specifications required for each, is listed in table 5–1. If the recommended equipment is not available, other equipment that meet the minimum specifications can be used.

NOTE

**Always use the lowest possible range on the VOM and AC voltmeter for maximum accuracy.**

## 5.7 MAINTENANCE.

## 5.8 ACCESS/DISASSEMBLY.

5.9 To obtain access to all the circuit boards in the TTS 2762 and TTS 2762R, proceed as follows:

TTS 2762

a. Loosen the five captive screws on the front panel.

b. Remove the retaining screws on bottom of case.

c. Lift unit out of case.

d. Remove the six screws from card cage support bracket (three on each side).

e. Remove the two retaining screws on card retainer bracket.

TTS 2762R

a. Loosen the two, half-turn retaining screws on rear of dust cover.

b. Remove the two retaining screws on card retainer bracket.

WARNING

**Lethal voltages are present in the power supply during operation and for several minutes after turnoff.**

CAUTION

**Do not remove termination board E95932 from numeric display without first mounting metal shorting clip over fingers of lower display board.**

Table 5–1. Test and Calibration Equipment

| Equipment Nomenclature | Required Specifications | Recommended Equipment |
|---|---|---|
| MF Sender | Fxd Freq: 700,900,1100,1300 1500,1700 Hz<br>Freq. tol: ±1%<br>Output Level: +1 dB min.<br>Output Impedance: 600 ohms | NEC TTS 59B MF Sender |
| Frequency Counter | Accuracy: ±1 count including time base accuracy<br>Min. Freq. Range: 600 Hz to 2000 Hz<br>Input Impedance: 100K | NEC TTS 80C Frequency Counter |
| Attenuator | Min. Range: 40 dB<br>Impedance: 600 ohms | Daven (circuit T) type VT 795 G |
| AC Voltmeter | Min. Range: –40 dB to +10 dB<br>Input Impedance: 10 M ohms | HP – 400FL AC Voltmeter |
| Oscillator | Frequency: 600 Hz to 1800 Hz min.<br>Max. Output Level: +10 dB min.<br>Output Impedance: 600 ohms | HP 209A Oscillator |
| VOM | Max. Range dc volts: 300 volts min.<br>Accuracy: 1.5% of full scale<br>Input Impedance: 20 k ohms/volt | Triplet Model 630NA |
| Oscilloscope | Vertical Sensitivity: 0.1v/cm min.<br>Sweep Speed: 10μs/cm min.<br>Probe: X1 | Tektronix 504 |

5.10 PERFORMANCE CHECK.

NOTE

**The following operations are simple, active signal response tests and do not include verification of the effective range of the MIN PULSE WIDTH, MIN REC LEVEL and VOLUME controls. Also the START ACC, AUDIO ACC, and EXT EQUIP RESET jacks are not checked.**

5.11 Remove the power cord from the cover compartment and connect it to the 115 Vac power plug. Insert the other end into a 115 Vac, ±10 Vac, 50 Hz to 60 Hz source.

5.12 Without additional connections to the unit, perform the following:

| ACTION | RESULT |
|---|---|
| a. Set AC POWER switch (S2) to ON position. | AC POWER pilot lamp lights. Frequency indicators may light briefly, then extinguish. All SUPERVISION lamps light. MF code lamps may be lit, Numeric display may show random digits. |
| b. Momentarily depress KP (OFF HOOK) /REM/MAN RESET switch (S5) to MAN position. | All frequency and code lamps extinguish. Any digits displayed on numeric display are extinguished. Supervision lamps remain lit. |

5.13 Test equipment needed for the following tests are listed below:

a. A loop dial pulse signaling device such as a DP telephone line and dialer; an NEC TTS 41SAU–2 or TTS 41SAU–4 Service Analyzer Unit; or an NEC TTS 59B MF Sender driving an A relay.

b. An E and M dial pulse signaling source, such as an NEC TTS 59B MF Sender or an NEC TTS 41SAU–4 Service Analyzer Unit.

5.14 Set the front panel controls of the TTS 2762, as follows:

a. AC POWER switch S2 to ON position.

b. RESET switch S5 to KP (OFF HOOK) position.

c. SPEAKER switch S3 to ON position.

d. VOLUME controls R1,R2 to midrange.

e. MAN/AGC switch S4 to AGC position.

f. MIN PULSE WIDTH control R4,R5 to 18ms.

g, MIN REC LEVEL control R3 to –23 dB.

h. DISPLAY FUNCTION switch S1, see table 5–2, step 1.

i. SUPV FUNCTION switch S6, see table 5–2, step 1.

5.15 Table 5–2 is keyed to the text by step numbers that are assoicated with the switch positions of the DISPLAY FUNCTION and SUPV FUNCTION switches, and input jacks ($L_1$, $L_2$, E&M), used during different stages of the performance test.

5.16 Proceed with the performance test by performing the actions and observing the results as described below:

| ACTION | RESULTS |
|---|---|
| a. Patch DP loop signaling device to TTS 2762. See table 5–2, step 1. | LINE REV lamp may extinguish (indicates line reversal). |
| b. Reverse input leads. | Line reverse lamp will change state. |
| c. Establish off-hook (common ground may be required to J18). | OFF HOOK lamp extinguishes. |

| ACTION | RESULT |
|---|---|
| d. Dial 0 through 9. | Speaker reproduces switching sounds. OFF HOOK lamp lights during each pulse with a slight delay after each transition. Numeric display indicates 0 to 9. |
| e. Establish on-hook for one second or longer; return to off-hook. | OFF HOOK lamp lights then extinguishes. Numeric display is cleared after on-hook/off-hook transition. |
| f. Set RESET switch (S5) to REM position. Dial 1,2,3. Establish on-hook for a second or longer; return to off-hook. | Numeric display indicates 1,2,3. The display is **not** cleared by on-hook/off-hook transition. |
| g. Short tip and ring of REMOTE RESET jack (J13 or J16 & J17) together or ground tip. | Numeric display cleared. |
| h. Return RESET switch (S5) to KP (OFF HK) position. Refer to table 5–2, step 2, and repeat directions included in paragraphs 5.16a, through 5.16e. | |
| i. Refer to table 5–2, step 3. Patch from the MF sender to the TTS 2762. Momentarily press RESET switch to MAN position, then return to KP (OFF HK) position. | |
| j. Send KP, 0 through 9, ST, 1,2,3,MF signals from MF sender. | Speaker reproduces tones. Frequency lamps light for duration of input. Code lamps KP1 and ST light. Numeric display indicates 0 through 9 only. Supervision lamps idle (lit), indicates idle condition. |
| k. Refer to table 5–2, step 4. Send KP, 0 through 9, 0 through 9 again, CD 11, CD12, and ST MF signals from MF sender. | ST lamp and numeric display extinghish after KP code. Numeric display indicates digits as received, 0 through 9 and 0 through 7. Last two digits (8 and 9) replace first two (0 and 1) on display; other fourteen digits remain displayed. KP,CD11,CD12 and ST lamps light after those codes are received. OFF HK and LINE REV lamps reflect line conditions. |
| l. Establish on-hook condition for approximately one second; return to off-hook. | Numeric and code lamp displays reset after on-hook/off-hook transition. OFF HK lamp reflects line condition. |

| ACTION | RESULT |
|---|---|
| m. Using step 5 of table 5–2, repeat actions in paragraphs 5.16,i, and 5.16,j, and observe same results. | |
| n. Using step 6 of table 5–2, repeat actions in paragraphs 5.16,i and 5.16,j, and observe same results. | |
| o. Using step 7 of table 5–2, repeat actions in paragaraphs 5.16,i, and 5.16,j and observe same results. | |
| p. Refer to table 5–2, step 8. Connect DP E lead signal source to input jack of the TTS 2726. Momentarily press RESET switch to MAN position and return to KP (OFF HK) position. | |
| q. Establish an off-hook condition. | E and OFF HOOK supervision lamps extinguish. |
| r. Dial 0 through 9. | Speaker reproduces switching sounds. OFF HOOK and E supervision lamps light during each pulse with the E lamp leading the OFF HOOK lamp. Numeric display indicates 0 through 9. |
| s. Establish on-hook for one second or longer; return to off-hook. | Numeric display clears after return to off-hook. |
| t. Using step 9 of table 5–2, repeat actions in paragraphs 5.16,q, and 5.16,r. | Results the same except the speaker does not reproduce signaling. |
| u. Refer to table 5–2, step 10. Connect DP M signal source to the input jack of the TTS 2762. Momentarily press RESET switch to MAN position. | |
| v. Establish an off-hook condition. | M and OFF HOOK supervision lamps extinguish. |
| w. Dial 0 through 9. | No signal reproduction from speaker. OFF HOOK and M supervision lamps light during each pulse with the E lamp leading the OFF HOOK lamp. Numeric display indicates 0 through 9. |
| x. Using step 11 of table 5–2, repeat actions in paragraphs 5.16,v, and 5.16,w. | Results the same, except speaker reproduces switching sounds. |

Table 5–2. Input Selection

| Step no. | DISPLAY FUNCTION SW (S1) | SUPV FUNCTION SW (S6) | Input Jack |
|---|---|---|---|
| 1 | DP,$L_1$ | E&M OR DP LOOP | $L_1$ (J4 or J5 or J14 & J15) |
| 2 | DP,$L_2$ | E&M OR DP LOOP | $L_2$ (J6 or J7) |
| 3 | MF,$L_1$ | E&M OR DP LOOP | $L_1$ (J4 or J5 or J14 & J15) |
| 4 | MF,$L_1$ | MF LOOP | $L_1$ (J4 or J5 or J14 & J15) |
| 5 | MF, BOTH | E&M OR DP LOOP | $L_1$ (J4 or J5 or J14 & J15) |
| 6 | MF,$L_2$ | E&M OR DP LOOP | $L_2$ (J6 or J7) |
| 7 | MF, BOTH | E&M OR DP LOOP | $L_2$ (J6 or J7) |
| 8 | DP,E | E&M OR DP LOOP | $L_1$ and E&M (J8 or J9;J4 or J5 or J14 & J15) |
| 9 | DP,E | MF LOOP | $L_1$ and E&M (J8 or J9; J4 or J5 or J14 & J15) |
| 10 | DP,M | MF LOOP | $L_2$ and E&M (J8 or J9; J6 or J7 |
| 11 | DP,M | E&M OR DP LOOP | $L_2$ and E&M (J8 or J9; J6 or J7) |

## 5.17 TROUBLESHOOTING.

5.18 To facilitate troubleshooting, a Troubleshooting Guide, table 5–3, is provided to allow the technician to isolate operational problems to individual printed circuit boards.

5.19 When using the Troubleshooting Guide, make the circuit checks (Possible Cause & Location) in the order listed, a before b, etc. It is advisable to perform the Performance Test prior to troubleshooting in order to validate any complaints.

5.20 The block diagrams and circuit descriptions located in section 4, along with the schematic diagrams located in section 7, serve as valuable supplements in troubleshooting to help the technician pinpoint the problem.

### WARNING

**Lethal voltages are present in the power supply during operation, and for several minutes after turnoff.**

Table 5–3. TTS 2762, Troubleshooting Guide

| SYMPTOM | POSSIBLE CAUSE & LOCATION |
|---|---|
| 1. Numeric display (U1) fails to light or digits are only half lit. Digits are incorrectly placed. Digits skip spaces or replace previously displayed digits. Digits stack up at one end of the numeric display. | a. Check power supply voltages.<br><br>b. An orange glow should be visible from rear of display.<br><br>c. These symptoms indicate a faulty display . Consult factory before removing display. |
| 2. One or more frequency lamps fail to light. | a. Check position of MAN/AGC switch (S4) (should be in AGC).<br><br>b. Speaker should reproduce MF tones thereby indicating a proper connection to the unit.<br><br>c. Set MAN/AGC switch to MAN position and turn MIN REC LEVEL control fully cw. If lamps still fail to light, return MAN/AGC switch to AGC position.<br><br>d. Check lamps by grounding pins A through F on PC3.<br><br>e. Check lamp drivers located on card 9.<br><br>f. Check selective detectors (cards 4,5,6) for proper outputs. |
| 3. One or more code lamps fail to light. | a. While sending codes, check to see that proper frequency lamps light.<br><br>b. Check lamps by grounding pins A through F on PC1.<br><br>c. Check for proper setting of the MIN PULSE WIDTH control (fully ccw).<br><br>d. Check lamp drivers located on card 9.<br><br>e. Check MF decoder (card 7) for proper decoding of MF frequencies. |

Table 5–3. (cont)

| SYMPTOM | POSSIBLE CAUSE & LOCATION |
|---|---|
| 4. E or M Supervision lamps fail to light and/or operate properly. | a. If lamps fail to light, (normal condition is on) check lamps by grounding pins C and B on PC2.<br><br>b. Check lamp drivers located on card 9.<br><br>c. Check E and M level detectors on card 3. |
| 5. OFF HOOK and/or LINE REV lamps fail to light and/or operate properly. | a. TTS 2762 must be grounded to obtain OFF HK.<br><br>b. Check lamps by grounding pins D and E on PC2.<br><br>c. Check lamp driver circuitry on card 10. |
| 6. Numeric display fails to reset. | a. Check position of reset switch.<br><br>b. Check reset circuitry on card 8. |
| 7. Ext Equip relay fails to operate. | a. Check relay K1 on card 3. |
| 8. Speaker is dead/noisy or has low volume. | a. Check position of speaker switch (should be ON).<br><br>b. Check volume controls for full cw setting.<br><br>c. Check audio circuits on card 3. |
| 9. ACC AUDIO output low or non-existant. | a. Check volume controls for full cw setting.<br><br>b. Check audio circuits located on card 3. |
| 10. Unit fails to display MF digits when in AGC mode of operation. | a. Check AGC circuitry on card 2. |
| 11. Unit fails to operate when in MAN mode of operation. | a. Check setting of MIN REC LEVEL control. |

Table 5—4. Power Supply Specifications

| Test Point* | DC Voltage | Ripple (max.) |
|---|---|---|
| Pin 21 | +12 V ± 0.1 V | 15 m Vac |
| Pin 20 | —12 V ± 0.3 V | 15 m Vac |
| Pin 22 | +5 V ± 0.2 V | 35 m Vac |
| Pin 4 | +250 V ±2.0V | 1.5 Vac |
| *All voltage readings taken with respect to ground (pin 1) | | |

g. Set AC POWER switch to OFF position.

h. Remove extender and install card 1 in its slot.

5.26 **MAIN INPUT (CARD 3).**

5.27 To calibrate the main input card, proceed as follows:

a. With AC POWER switch in OFF position, remove card 3.

b. Plug card 3 into extender and insert into card 3 slot.

c. Set following front panel controls on TTS 2762 to positions indicated:

1. DISPLAY FUNCTION switch to MF BOTH.

2. MAN/AGC switch to AGC.

3. SPEAKER switch to ON.

4. AC POWER switch to ON.

d. Patch from TTS 59B MF Sender to attenuator input.

e. Patch from attenuator output to one of $L_1$ jacks located on TTS 2762 front panel.

f. Using MF sender, send a continuous MF signal of digit 6 at a level of +1.0 dBm ±0.1 dBm.

g. Connect HP 400FL AC Voltmeter to junction of RV1 and R38 (referenced to ground) on card 3.

h. Adjust attenuator until a level of —15 dBm ±0.1 dBm is observed on ac voltmeter.

i. Disconnect ac voltmeter from junction of RV1 and R38 and connect it to Test Point 1.

j. Without changing input level, measure and record level observed on ac voltmeter.

k. Remove patch cord from $L_1$ input jack and insert into one of the $L_2$ input jacks. **Do not** readjust input level.

l. Disconnect ac voltmeter from TP1 and connect to TP2 on card 3.

m. Observe signal level monitored by the ac voltmeter and, if necessary, adjust potentiometer R49 to obtain a level equal to the recorded level monitored at TP1.

n. Disconnect ac voltmeter from TP2 and connect to TP3.

o. Level monitored at TP3 should be —15 dBm ±0.1 dBm. If necessary, adjust potentiometer R51 to obtain this reading.

p. Disconnect ac voltmeter from card 3 and connect it to attenuator output.

q. Set attenuator to obtain a —13 dBm, ±0.1 dBm indication on ac voltmeter.

r. Set TTS 2762 MIN REC LEVEL control to −13 dBm position.

s. Set MAN/AGC switch to MAN position.

t. Adjust potentiometer R7 on card 3 until 1100 and 1300 lamps on TTS 2762 front panel are just lit (not flickering).

u. Set TTS 2762 AC POWER switch to OFF position.

v. Disconnect all test equipment from TTS 2762; remove extender and install card 3 in slot 3.

5.28 **MF INPUT (CARD 2).**

5.29 To calibrate the MF Input card, proceed as follows:

a. With AC POWER switch in OFF position, remove card 2 from TTS 2762.

b. Plug card 2 into extender and insert into card 2 slot.

c. Perform steps described in paragraphs 5.27 c,d, and e.

d. Using MF sender, send a continuous MF signal of digit 6 at a level of −6 dBm ±0.1 dBm.

e. Using ac voltmeter, monitor test point two (TP2) on card two, with reference to ground. Meter should indicate −27 dB ±0.2 dB; if not, adjust potentiometer R20 for correct indication.

f. Disconnect ac voltmeter from TTS 2762 and connect it to output connectors of attenuator.

g. Set attenuator to obtain a −25 dBm, ±0.1 dBm indication on ac voltmeter.

h. Adjust potentiometer R33 clockwise until 1100 and 1300 lamps on TTS 2762 are extinguished.

i. Slowly adjust R33 counterclockwise until same frequency lamps are just lit (not flickering).

j. Set TTS 2762 AC POWER switch to OFF position.

k. Disconnect all test equipment from TTS 2762; remove extender card and install card 2 into slot 2.

5.30 **SELECTIVE DETECTORS CARDS 4,5,6.**

5.31 The following calibration procedure is for tuning filter F1 on card 4 to a center frequency of 700 Hz. The format is the same for filter F2 and for filters F1 and F2 on cards 5 and 6.

5.32 Refer to figure 5−1 for calibration controls and their locations and to table 5−5 for filter identification and associated frequencies.

5.33 Prior to calibration of the selective detector card, isolate the input filter F1 (card 4, 700 Hz), as follows:

NOTE

**Use proper soldering techniques in performing the following steps.**

a. With AC POWER switch in OFF position, remove card 4 from TTS 2762.

b. Unsolder the end of resistor R4 common with capacitor C1.

c. Unsolder the end of resistor R11 common with pin 5 on printed circuit board.

5.34 To isolate input of filter F2, perform the following steps:

a. Unsolder the end of resistor R27 common with capacitor C9.

b. Unsolder the end of resistor R34 common with pin 16 of printed circuit board.

5.35 Prior to setting the AC POWER switch of the TTS 2762 to the ON position, plug card 4 into the extender and install in slot 4. Remove card 3.

5.36 Initial set up of the test equipment is as

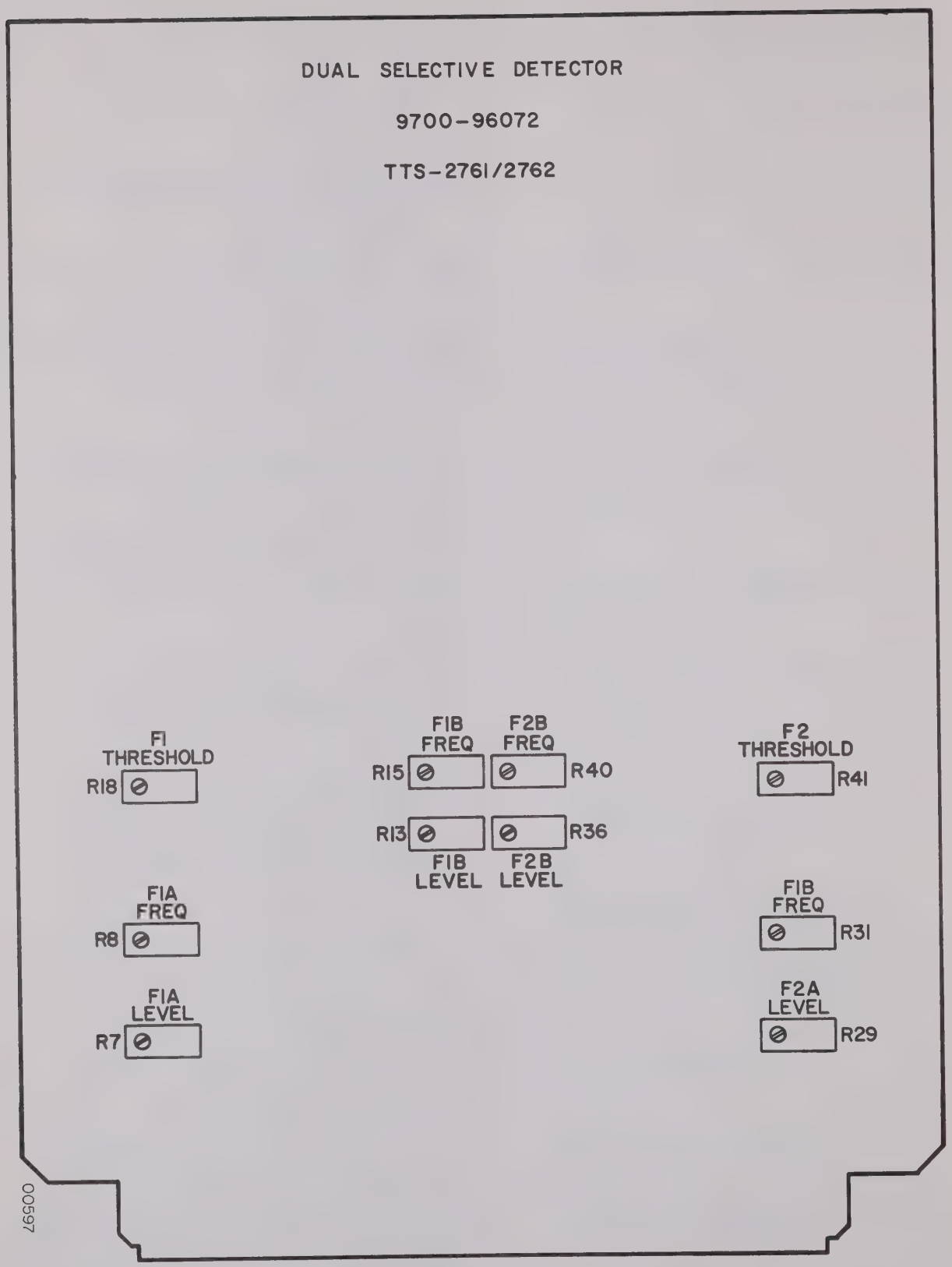



Figure 5—1. TTS 2762, Dual Selective Detector Calibration Control Function and Location.

follows:

a. Patch from HP209A oscillator output jacks to input of attenuator and TTS 80C frequency counter (TTS 80C IMPEDANCE switch in BRIDGE position).

b. Connect attenuator output to the unsoldered end of resistor R4 and ground (pin B).

c. Connect output of oscillator to input of ac voltmeter.

d. Set output frequency of oscillator to 700 Hz and output level for a −25 dB ±0.1 dB reading on ac voltmeter.

e. Disconnect ac voltmeter from oscillator and connect to output terminals of attenuator.

f. Set attenuator for a −30 dBm ±0.1 dBm reading on ac voltmeter.

g. Disconnect ac voltmeter from attenuator, and connect it to junction of potentiometer R7 and resistor R9, with reference to ground (pin B).

h. Connect a lead from chassis ground, on the TTS 2762, to chassis ground of Tektronix 504 oscilloscope.

i. Connect input of oscilloscope to pin F on card 4.

5.37 Set the oscilloscope controls as follows:

a. Sweep Time/cm to 5.0ms/cm.

b. Input to AC.

c. Vertical Sensitivity to 5V/cm.

d. Triggering:

1. Trigger Level to Auto.

2. Source to Internal.

3. Coupling to AC.

4. Slope to plus.

5.38 Adjust the attenuator output level for a −30 dBm, ±0.2 dBm reading on the ac voltmeter.

5.39 With the intensity, focus, and position controls on the oscilloscope set to provide a good mid-screen display of the signal, one of two conditions of the waveform should appear:

a. An apparent straight line, or

b. Oscillations (distorted waveforms).

5.40 If the sweep is an apparent straight line, adjust potentiometer R7 (F1A) in a counterclockwise direction (figure 5−1), until the filter goes into oscillation and then in a clockwise direction until the oscillations disappear.

5.41 If oscillations are already present, adjust potentiometer R7 in a clockwise direction until the oscillations disappear.

5.42 Adjust the oscillator frequency until a peak level is observed on the ac voltmeter. This indicates the peak frequency of the filter. Adjust R7 until the ac voltmeter indicates −10 dBm, ±0.1 dBm.

5.43 Observe the frequency counter. It should indicate 689 Hz, ±1.0 Hz at the peak frequency of the first filter section (F1A). If the frequency is too low, adjust R8 in a clockwise direction until the proper peak frequency is obtained. The peak frequency is found by adjusting the oscillator frequency after each adjustment of R8 until the peak level indication is coincident with the desired peak frequency. Then adjust potentiometer R7 for a −10 dBm level indication on the ac voltmeter.

5.44 To calibrate the second filter section (F1B) for peak frequency, connect the test equipment in the following manner:

a. Disconnect attenuator from R4 and connect to the unsoldered end of R11.

b. Disconnect ac voltmeter from junction of potentiometer R7 and R9 and connect to the junction of potentiometer R13 and R16.

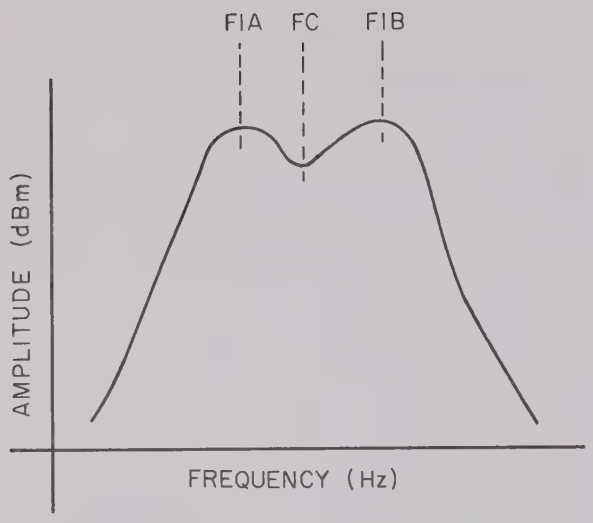



**Figure 5–2. TTS 2762, 700 Hz Selective Detector, Response After Filter Frequency Calibration.**

5.45 To calibrate the second filter section (F1B), follow the same procedure outlined in paragraphs 5.39 through 5.43 for the first filter section F1A, except for the following deviations:

a. Peak frequency is 711 Hz, ±1.0 Hz.

b. Adjust potentiometer R13 instead of R7 for level, and potentiometer R15 instead of R8 for peak frequency.

NOTE

**The deviations reflect the information found on table 5–5 and figure 5–1.**

5.46 After the two filter sections are calibrated, disconnect the attenuator from R11 and connect to pin H of card 4.

5.47 Set the TTS 2762 AC POWER switch to OFF position.

5.48 Solder resistors R4 and R11 back onto the printed circuit board.

5.49 Set the TTS 2762 AC POWER switch to ON position.

5.50 Set the output frequency of the oscillator to 100 Hz, ±1.0 Hz below the desired center frequency, in this case 600 Hz, since the center frequency is 700 Hz as indicated on table 5–5.

5.51 While observing the ac voltmeter and frequency meter, slowly adjust the oscillator frequency toward 800 Hz (100 Hz above center frequency) and note the meter readings. The first peak should represent approximately 689 Hz, the valley approximately 700 Hz, and the second peak approxiamtely 711 Hz. At this time, the peaks may be of any level. See figure 5–2 for a graphic representation of level and frequency indications.

5.52 After having observed the pattern, tune to the greater peak and observe the indication on the frequency counter. If the frequency is approximately 689 Hz, the peak is F1A. If the peak is approximately 711 Hz, the peak is F1B. This may be determined by referring to table 5–5 for card 4–F1A,F1B.

5.53 Adjust the potentiometer for whichever peak has been tuned, potentiometer R7 for peak F1A; potentiometer R13 for peak F1B. Adjust the potentiometer in a clockwise direction to decrease the level. Do not decrease below the level of center frequency (valley).

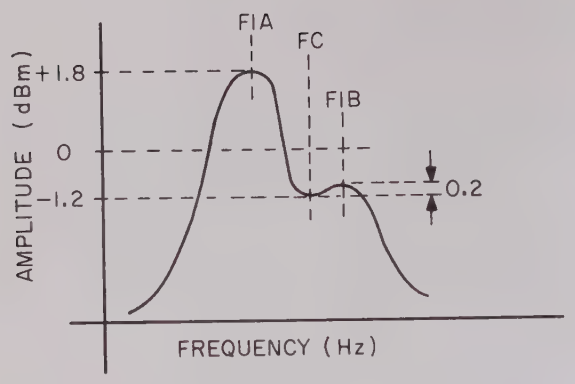
5.54 For example: Referring to figure 5–3, if the highest peak was F1A, its amplitude was +1.8 dBm, and the amplitude of the valley was –1.2 dBm, potentiometer R7 would be turned clockwise until the peak of F1A amplitude was –0.8 dBm, or approximately 0.4 dB higher than the valley.

5.55 Tune the oscillator to the second peak level (F1B) on the ac voltmeter.

5.56 Adjust potentiometer R13 slightly in a clockwise direction until the level is –0.8 dBm, or 0.4 dB above the center frequency amplitude, the same as F1B.

5.57 Since adjusting the peaks has an effect on the overall response pattern, it may be necessary to continue tuning and adjusting R7 and R13 until a response similar to figure 5–4 is obtained.

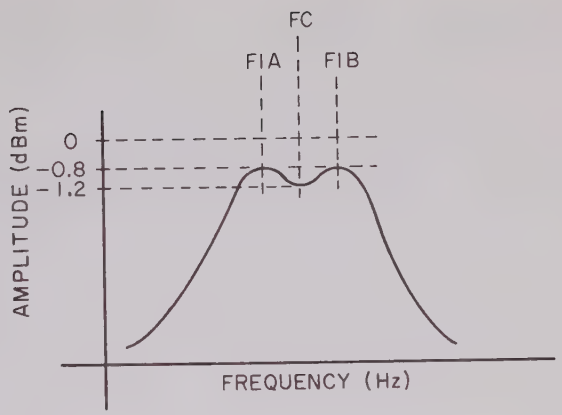
5.58 Tune the oscillator to the valley of the response curve (700 Hz) and observe the oscilloscope to see if the output on pin F is high (approximately +5.0 Vdc).




FIA = 689 Hz
FC = 700 Hz
FIB = 711 Hz

00602

**Figure 5–3. TTS 2762, 700 Hz Selective Detector, Response After Calibration of F1A Level.**




FIA = 689 Hz
FC = 700 Hz
FIB = 711 Hz

00604

**Figure 5–4. TTS 2762, 700 Hz Selective Detector, Response After Calibration of F1A and F1B Levels.**

5.59 Set the oscillator frequency to 100 Hz below center frequency then, while observing the ac voltmeter, frequency counter and oscilloscope, slowly sweep the range of frequencies from 100 Hz below to 100 Hz above center frequency. Check for the following:

a. Peaks are within 0.4 dB of the valley in the response.

b. Frequencies should be within 3 Hz low of F1A (689 Hz) before the output at pin F goes high, as shown on the oscilloscope, and within 3 Hz above F1B (711 Hz) before it goes low.

5.60 Disconnect the ac voltmeter from the junction of potentiometer R13 and R18, and connect to the output terminals of the attenuator.

5.61 Set the oscillator frequency to 700 Hz, ±1.0 Hz.

5.62 Set the attenuator for a –37 dBm reading on the ac voltmeter.

5.63 The oscilloscope should indicate one of two conditions, a high (approximately +5.0 Vdc) or a low (approximately 0 Vdc) output appearing on pin F.

5.64 If a high output is monitored, adjust potentiometer R18 (threshold) in a counterclockwise direction until the output goes low; then clockwise until the output just goes high.

5.65 If a low output is monitored, adjust potentiometer R18 clockwise until the output at pin F just goes high.

5.66 Set the TTS 2762 AC POWER switch to the OFF position.

5.67 This completes the calibration of the 700 Hz selective detector located on card 4. Proceed to calibrate the 900 Hz selective detector on this same card and all other selective detectors on cards 5 and card 6, by using the same format and referring to table 5–5, figure 5–1, and figure 7–5, Dual Selective schematic diagram, for assoicated filter frequencies, calibration controls, and test point locations.

5.68 **MF REGISTER (CARD 8).**

NOTE

**To calibrate the MF Register card, it is necessary to interrupt the MF input signal from the MF sender to provide 100ms, ±1.0ms and 18ms, ±1.0ms of MF at a rate of 4 and 20 pulses per second respectively.**

5.69 With the TTS 2762 AC POWER switch in the OFF position, remove card 8.

Table 5–5. Filter Frequency Chart For Selective Detectors (Cards 4,5,6)

| Card | Filter | Center Frequency (Hz) | Filter Section | Peak Frequency (Hz) |
|---|---|---|---|---|
| 4 | F1 | 700 | F1A | 689 |
| | | | F1B | 711 |
| | F2 | 900 | F2A | 886 |
| | | | F2B | 914 |
| 5 | F1 | 1100 | F1A | 1083 |
| | | | F1B | 1117 |
| | F2 | 1300 | F2A | 1280 |
| | | | F2B | 1320 |
| 6 | F1 | 1500 | F1A | 1477 |
| | | | F1B | 1523 |
| | F2 | 1700 | F2A | 1674 |
| | | | F2B | 1726 |

5.70 Plug card 8 into extender and install in card 8 slot.

5.71 Set the TTS 2762 front panel controls to the positions indicated:

a. DISPLAY FUNCTION switch to MF BOTH.

b. MAN/AGC switch to AGC.

c. SPEAKER switch to ON.

d. MIN REC LEVEL control to 100ms

e. AC POWER switch to ON.

5.72 Connect the MF sender to a device that can be set to provide a 100 millisecond burst of MF at a rate of 4 pulses per second.

5.73 Connect the input, of the TTS 2762, to the interrupted MF source that provides 100 millisecond of CD11 code signal with a level of −22 dBm, ±1.0 dBm at a rate of 4 pulses per second.

5.74 Connect a lead from the TTS 2762 chassis ground, to the oscilloscope chassis ground.

5.75 Connect the input of the oscilloscope to the junction of R16 and pin 1 of the intergrated circuit U7 (U7B) on card 8.

5.76 Set the oscilloscope controls, as follows:

a. Sweep Time/cm to 5.0ms/cm.

b. Input to DC

c. Vertical Sensitivity to 5.0V/cm.

d. Triggering:

1. Trigger Level to Auto

2. Source to Internal

3. Coupling to AC

4. Slope to minus

5.77 The oscilloscope should display a negative going pulse (4.0ms, ±2.0ms). If necessary, adjust potentiometer R20 on card 8 to obtain the proper pulse width.

5.78 Set the MF input signal to $L_1$ for 18 milliseconds in duration at a rate of 20 pulses per second.

5.79 Set the MIN REC LEVEL control to 18ms.

5.80 Observe the waveform on the oscilloscope, it should be a negative going pulse (4.0ms, ±2.0ms).

5.81 Disconnect all test equipment from the TTS 2762.

5.82 Set AC POWER switch to OFF position.

5.83 Remove the extender and install card 8 back into the slot 8.

# ELECTRONIC PARTS LIST

## 6.1 INTRODUCTION.

6.2 This section provides the parts list and assoicated component location drawings for easy location and identification of parts. Table 6–1 provides a list of FSCM (Federal Supply Code of Manufacturers) code numbers and corresponding manufacturers. Tables 6–2 through 6–18 are the parts lists and figures 6–1 through 6–14 are the component location diagrams for the TTS 2762 and TTS 2762R.

**Table 6–1. List of Manufacturers**

| Code | Manufacturer |
|---|---|
| 01121 | Allen Bradley, Milwaukee, Wis. 53212 |
| 01295 | Texas Instrument Inc., Dallas, Texas 75222 |
| 02660 | Amphenol Corp., Broadview, Ill. 60153 |
| 04713 | Motorola Inc., Phoenix, Arz. 85008 |
| 05397 | Union Carbide Corp., Cleveland, Ohio 44101 |
| 06486 | IRC, Lynn, Mass. 01905 |
| 09353 | C & K Components Inc. Watertown, Mass. 02172 |
| 12065 | Transitron Electronics Corp., Boston, Mass 02128 |
| 12954 | Dickson Electronics Corp., Scottsdale, Arz. 85252 |
| 13606 | Sprague Electric Co., Concord, N.H. 03301 |
| 17538 | Precision Electronics, Mansfield, Mass. 02050 |
| 18324 | Signetics Corp., Sunnyvale, Calif. 94086 |
| 19701 | Electra/Midlands, Mineral Wells, Texas 76067 |
| 22650 | Whale Electronics, Nashville, Tenn. 37204 |
| 27735 | F–DYNE Electric Co.. Fairfield, Conn. 06430 |
| 44655 | Ohmite Mfg., Co, Skokie, Ill. 60076 |
| 49671 | RCA Corp., N.Y., New York 10020 |
| 71590 | Centralab Electronics, Milwaukee, Wis. 53201 |
| 71744 | Chicago Miniatur Lamp, Chicago, Ill. 60640 |
| 72982 | Erie Technological Products, Erie, Pa. 16512 |
| 73138 | Beckman Instruments, Fullerton, Calif. 92634 |
| 74199 | Quam Nichols Co., Chicago, Ill. 60637 |
| 75915 | Littlefuse Inc., Des Planes, Ill. 60016 |
| 81071 | Schauer Mfg., Co., Cincinnati, Ohio 45242 |
| 81073 | Grayhill, Inc. La Grange, Ill. 60525 |
| 82389 | Switchcraft Inc., Chicago, Ill. 60630 |
| 83330 | Smith Inc., Brooklyn, N.Y. 11207 |

Table 6–2. TTS 2762, Overall Assembly Parts List

| REFERENCE DESIGNATOR | DESCRIPTION | MFGR. | MFGR. PART NO. | N.E.C. PART NO. |
|---|---|---|---|---|
| CAR1 | PS BD ASSY 95875 | | | A276110010 |
| CAR2 | MF INPUT A60 ASSY 95883 | | | A276110011 |
| CAR3 | MAIN INPUT ASSY 96285 | | | A276200012 |
| CAR4 | DUAL SELECTIVE DET ASSY | | | A276110029 |
| CAR5 | DUAL SELECTIVE DET ASSY | | | A276110030 |
| CAR6 | DUAL SELECTIVE DET ASSY | | | A276110031 |
| CAR7 | DECODER ASSY 95874 | | | A276110016 |
| CAR8 | MF REGISTER CARD 8 | | | A276200018 |
| CAR9 | BUFFER CARD ASSY | | | A276200010 |
| CAR10 | DC INPUT ASSY CARD 10 | | | A276200015 |
| DS1 | T-2 1/15W 00 105V | 71744 | NE2-D | 730000700 |
| F1 | 1A 00 250V | 75915 | 3AG | 863100400 |
| J1 | 5A 00 600V | 02660 | 225-22821-101 | 651701900 |
| J2 | 33PIN | ELCO | 00-8026-033-000-801 | 653203500 |
| J3 | 3-PIN MALE RECEPT-GND | 82389 | AC3G | 652300100 |
| J4 | SPECIAL 00 | 82389 | 5J-1329 | 650401300 |
| J5 | SAME AS J4 | | | |
| J6 | SAME AS J4 | | | |
| J7 | SAME AS J4 | | | |
| J8 | SAME AS J4 | | | |
| J9 | SAME AS J4 | | | |
| J10 | SAME AS J4 | | | |
| J11 | SAME AS J4 | | | |
| J12 | SAME AS J4 | | | |
| J13 | SAME AS J4 | | | |
| J14 | BINDING POST-BLK | 81073 | 29-1B | 652400300 |
| J15 | BINDING POST-RED | 81073 | 29-1R | 652400400 |
| J16 | SAME AS J14 | | | |
| J17 | SAME AS J15 | | | |
| J18 | BINDING POST METAL GND | 83330 | 137SP | 652500100 |
| J19 | 5A 00 600V | 02660 | 225-20621-101 | 651700200 |
| LS1 | SPEAKER 45 OHM | 74199 | 25A07-Z45 | 926000200 |
| R1 | 1K 2W 10% | 44655 | CU-1021 | 232001020 |
| R2 | SAME AS R1 | | | |
| R3 | 5K 2W 10% | 44655 | CU-5021 | 232005020 |
| R4 | POT DUAL 150K-50K | AB | JJ97480 | 238001540 |
| R5 | SAME AS R4 | | | |
| R6 | 11.5K 1/8W 1% | 19701 | MF5C | 220211521 |
| R7 | 105K 1/8W 1% | 19701 | MF5C | 220210531 |
| R8 | 47- 1/2W 10% | 01121 | TYPE EB | 200204706 |
| S1 | 1A 28V | OAK | 5-31913-111 | 626301400 |
| S2 | SPDT 5A 00 28V | 09353 | 7101P | 620400100 |
| S3 | SAME AS S2 | | | |
| S4 | SAME AS S2 | | | |
| S5 | 4PDT | C+K | 7413P | 620402300 |
| S6 | 4PDT 5A 80 28V | 09353 | 7401P | 620401600 |

## Table 6–3. TTS 2762, Power Supply, Card 1 (95875) Parts List

| REFERENCE DESIGNATOR | DESCRIPTION | | | | MFGR. | MFGR. PART NO. | N.E.C. PART NO. |
|---|---|---|---|---|---|---|---|
| C1 | 20UF | | | 350V | 13606 | 39D206F350FL4 | 300002060 |
| C2 | .022UF | | 10% | 400V | 13606 | 4PS-S22 | 321202230 |
| C3 | 1100UF | | | 30V | 13606 | 39D118G030GP4 | 300001180 |
| C4 | SAME AS C3 | | | | | | |
| C5 | 4.7UF | | 10% | 25V | 05397 | T330A475K025AS | 310004751 |
| C6 | SAME AS C5 | | | | | | |
| C7 | 2.2UF | | 10% | 35V | 05397 | T330A225K035AS | 310002250 |
| C8 | 4000UF | | 00 | 15V | 13606 | 39D408G015JL4 | 300004081 |
| C9 | 22UF | | 10% | 6V | 05397 | T330A226K006AS | 310002260 |
| C10 | 100UF | | 00 | 16V | 13606 | TE-1162 | 300201071 |
| CR1 | A38AH | | 00 | 600V | 01295 | 1N2071 | 560020710 |
| CR2 | SAME AS CR1 | | | | | | |
| CR3 | SAME AS CR1 | | | | | | |
| CR4 | SAME AS CR1 | | | | | | |
| CR5 | | 1A | | 50V | 04713 | MDA920-A2 | 565009202 |
| CR6 | DO-7 | 250MW | 5% | 6.2V | 12954 | 1N823 | 563008230 |
| CR7 | SAME AS CR5 | | | | | | |
| CR8 | | 2.5A | | 50V | 04713 | MDA960-1 | 565009601 |
| Q1 | | 10W | | 200V | 49671 | 2N5416 | 552054160 |
| Q2 | TO5 | 10W | | 350V | 49671 | 2N3439 | 550034390 |
| Q3 | TO92MSS | 310MW | 00 | 40V | 04713 | 2N3905 | 552039050 |
| Q5 | TO92HSS | 310MW | 00 | 40V | 04713 | 2N3903 | 550039030 |
| Q6 | SAME AS Q5 | | | | | | |
| Q8 | SAME AS Q3 | | | | | | |
| Q9 | SAME AS Q3 | | | | | | |
| Q11 | SAME AS Q5 | | | | | | |
| Q12 | TO5HNS | 1W | 00 | 65V | 49671 | 2N2102 | 550021020 |
| R1 | 10- | 1/4W | 10% | | 01121 | TYPE CB | 200101006 |
| R2 | 1.8K | 1/4W | 10% | | 01121 | TYPE CB | 200101826 |
| R3 | 820K | 1/2W | 10% | | 01121 | TYPE EB | 200208246 |
| R4 | 120K | 1W | 5% | | 44655 | LITTLE DEVIL | 200701245 |
| R5 | 8.2K | 1/2W | 10% | | 01121 | TYPE EB | 200208226 |
| R6 | 511K | 1/4W | 1% | | 19701 | MF6C | 220551131 |
| R7 | 2K | 1/2W | 10% | 200V | HI-PUT | 62P2K | 232702026 |
| R8 | 23.7K | 1/8W | 1% | | 19701 | MF5C | 220223721 |
| R9 | 1M | 1/4W | 10% | | 01121 | TYPE CB | 200101056 |
| R10 | 7150- | 1/8W | 1% | | 19701 | MF5C | 220271511 |
| R11 | 47K | 1/4W | 10% | | 01121 | TYPE CB | 200104736 |
| R12 | 2.7K | 1/4W | 10% | | 01121 | TYPE CB | 200102726 |
| R13 | 1- | 1/2W | 10% | | 01121 | EB | 200200106 |
| R14 | 1.2K | 1/2W | 10% | | 01121 | TYPE EB | 200201226 |
| R15 | | | | | | | 220205111 |
| R16 | SAME AS R15 | | | | | | |
| R17 | 5.62K | 1/8W | 1% | | 19701 | MF5C | 220256211 |
| R18 | SAME AS R12 | | | | | | |
| R19 | SAME AS R13 | | | | | | |
| R20 | SAME AS R14 | | | | | | |
| R21 | 10K | 1/8W | 1% | | 19701 | MF5C | 220210021 |
| R22 | SAME AS R21 | | | | | | |
| R23 | SAME AS R12 | | | | | | |

Table 6–3. (cont)

| REFERENCE DESIGNATOR | DESCRIPTION | MFGR. | MFGR. PART NO. | N.E.C. PART NO. |
|---|---|---|---|---|
| R24 | .39- 2W 5% | 06486 | BWH | 210203985 |
| U1 | 8PDIL 00MW 00 180 | 18324 | N5741V | 500057410 |
| U2 | SAME AS U1 | | | |
| U3 | SAME AS U1 | | | |
| U4 | SAME AS U1 | | | |

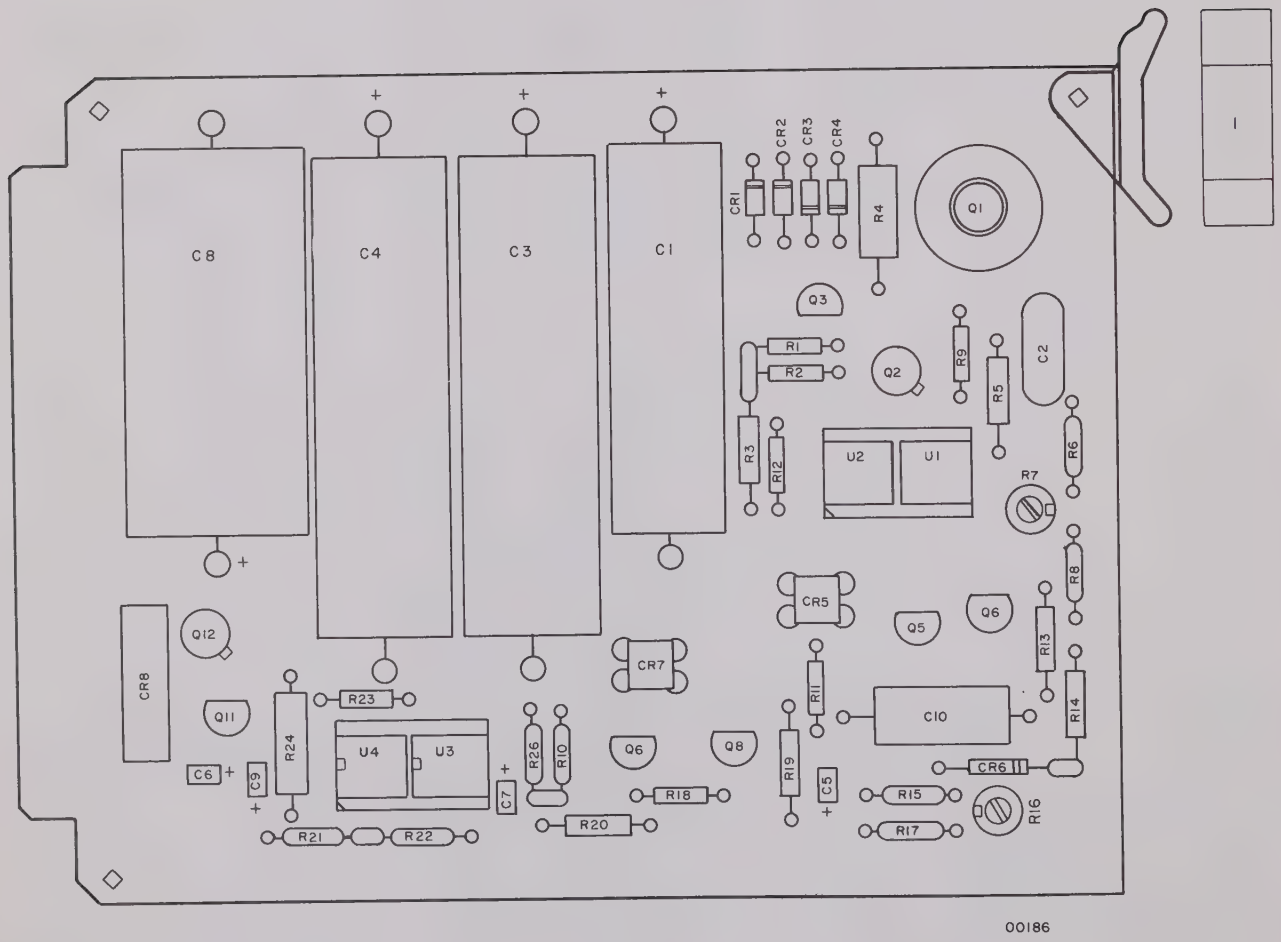



Figure 6–1. TTS 2762, Power Supply, Card 1 (95875) Component Location

Table 6–4. TTS 2762, Transformer Assembly Parts List

| REFERENCE DESIGNATOR | DESCRIPTION | MFGR. | MFGR. PART NO. | N.E.C. PART NO. |
|---|---|---|---|---|
| J20 | 5A 00 600V | 02660 | 225-22221-101 | 651701000 |
| Q4 | LPA 25W 00 40V | 04713 | 2N4910 | 550049100 |
| Q7 | LPA 25W 00 40V | 04713 | 2N4898 | 552048980 |
| Q10 | TO3LPA 115W 00 60V | 49671 | 2N3055 | 550030550 |
| T1 | P115 S 6@9 1@200 | 17538 | NEC4A | 420200600 |

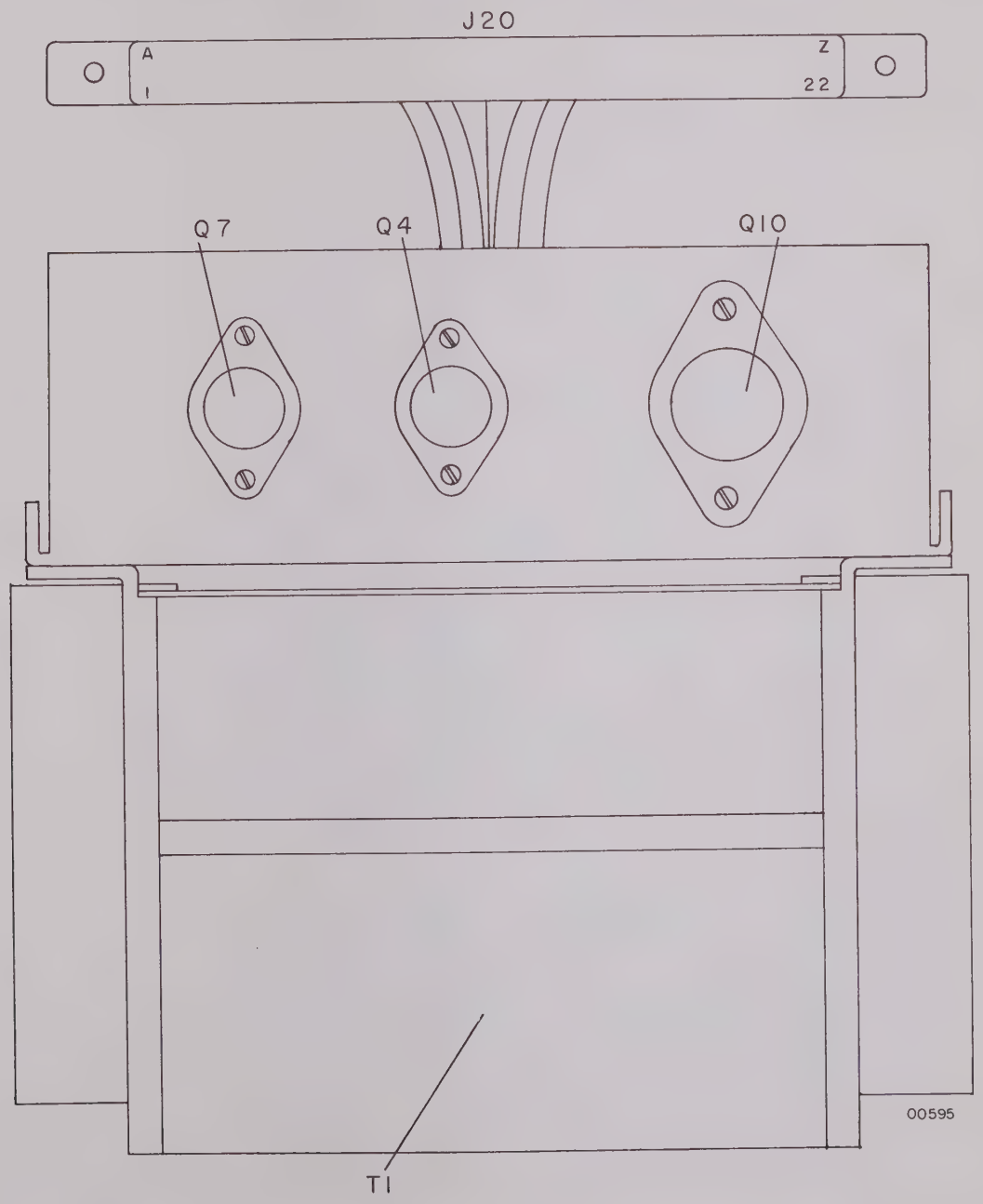



Figure 6–2. TTS 2762, Transformer Assembly Component Location

## Table 6–5. TTS 2762, MF Input, Card 2 (95883) Parts List

| REFERENCE DESIGNATOR | DESCRIPTION | | | | MFGR. | MFGR. PART NO. | N.E.C. PART NO. |
|---|---|---|---|---|---|---|---|
| C1 | .01UF | | 10% | 100V | 13606 | 225P10391WD3 | 320001030 |
| C2 | SAME AS C1 | | | | | | |
| C3 | SAME AS C1 | | | | | | |
| C4 | SAME AS C1 | | | | | | |
| C5 | 1UF | | 10% | 35V | 05397 | T330A105K035AS | 310001051 |
| C6 | 15UF | | 10% | 10V | 05397 | T330A156K010AS | 310001560 |
| C7 | 2.2UF | | 10% | 35V | 05397 | T330A225K035AS | 310002250 |
| C8 | 10UF | | 10% | 10V | 05397 | T330A106K010AS | 310001060 |
| C9 | SAME AS C8 | | | | | | |
| C10 | SAME AS C8 | | | | | | |
| CR1 | DO35 | 500MW | 00 | 20V | 12065 | 1N4148 | 560041480 |
| Q1 | TO92 | 1-5MA | 00 | 25D | 04713 | MPF103 2N5457 | 554001030 |
| Q2 | TO92 | 2-9MA | 00 | 400V | 04713 | MPF152 2N5461 | 555001520 |
| Q3 | SAME AS Q1 | | | | | | |
| R1 | 38.3K | 1/8W | 1% | | 19701 | MF5C | 220238321 |
| R2 | 75K | 1/8W | 1% | | 19701 | MF5C | 220275021 |
| R3 | 22K | 1/4W | 10% | | 01121 | TYPE CB | 200102236 |
| R4 | 1K | 1/4W | 10% | | 01121 | TYPE CB | 200101026 |
| R5 | SAME AS R1 | | | | | | |
| R6 | SAME AS R2 | | | | | | |
| R7 | SAME AS R3 | | | | | | |
| R8 | SAME AS R4 | | | | | | |
| R9 | 3.9K | 1/4W | 10% | | 01121 | TYPE CB | 200103926 |
| R10 | 1.8K | 1/4W | 10% | | 01121 | TYPE CB | 200101826 |
| R11 | 100K | 1/4W | 10% | | 01121 | TYPE CB | 200101046 |
| R12 | 10K | 1/4W | 10% | | 01121 | TYPE CB | 200101036 |
| R13 | 47K | 1/4W | 10% | | 01121 | TYPE CB | 200104736 |
| R14 | SAME AS R13 | | | | | | |
| R15 | 10- | 1/4W | 10% | | 01121 | TYPE CB | 200101006 |
| R16 | 2.7M | 1/4W | 10% | | 01121 | TYPE CB | 200102756 |
| R17 | 1.5K | 1/4W | 10% | | 01121 | TYPE CB | 200101526 |
| R18 | 3.3K | 1/4W | 10% | | 01121 | TYPE CB | 200103326 |
| R19 | SAME AS R17 | | | | | | |
| R20 | 5K | 1/2W | 10% | 200V | HILIPOT | 62P5K | 232705026 |
| R21 | 6.8K | 1/4W | 10% | | 01121 | TYPE CB | 200106826 |
| R22 | 2.2K | 1/4W | 10% | | 01121 | TYPE CB | 200102226 |
| R23 | 120- | 1/4W | 10% | | 01121 | TYPE CB | 200101216 |
| R24 | SAME AS R4 | | | | | | |
| R25 | SAME AS R23 | | | | | | |
| R26 | SAME AS R22 | | | | | | |
| R27 | SAME AS R22 | | | | | | |
| R28 | SAME AS R18 | | | | | | |
| R29 | SAME AS R17 | | | | | | |
| R30 | SAME AS R17 | | | | | | |
| R31 | 27K | 1/4W | 10% | | 01121 | TYPE CB | 200102736 |
| R32 | 4.7M | 1/4W | 10% | | 01121 | TYPE CB | 200104756 |
| R33 | SAME AS R20 | | | | | | |
| R34 | SAME AS R3 | | | | | | |
| R35 | 3.9M | 1/4W | 10% | | 01121 | TYPE CB | 200103956 |
| R36 | SAME AS R11 | | | | | | |

Table 6–5. (cont)

| REFERENCE DESIGNATOR | DESCRIPTION | MFGR. | MFGR. PART NO. | N.E.C. PART NO. |
|---|---|---|---|---|
| R37 | 470- 1/4W 10% | 01121 | TYPE CB | 200104716 |
| SV1 | SILICON | 81071 | SV-1 | 565510000 |
| U1 | 8PDIL 80MW 00 180 | 18324 | N5558V | 500055580 |
| U2 | SAME AS U1 | | | |
| U3 | 2PT05M 00 | 49671 | CA3026 | 500030260 |

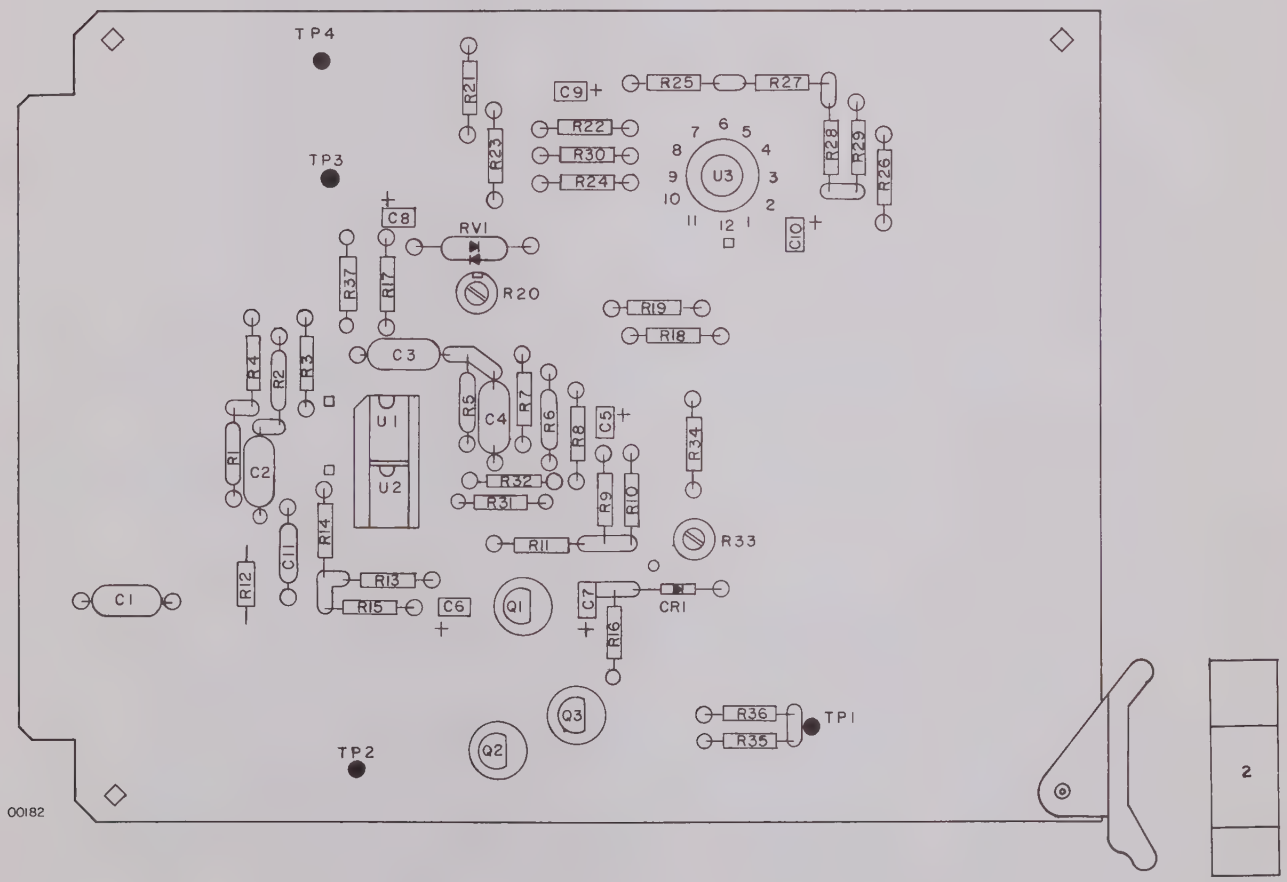



Figure 6–3. TTS 2762, MF Input (AGC) Card 2 (95883), Component Location

## Table 6–6. TTS 2762, Main Input, Card 3 (96285) Parts List

| REFERENCE DESIGNATOR | DESCRIPTION | | | | MFGR. | MFGR. PART NO. | N.E.C. PART NO. |
|---|---|---|---|---|---|---|---|
| C1 | 50UF | | 00 | 16V | 13606 | TE1160 | 300205060 |
| C2 | SAME AS C1 | | | | | | |
| C3 | .01UF | | 10% | 100V | 13606 | 225P10391WD3 | 320001030 |
| C4 | .022UF | | 10% | 100V | 13606 | 225P22391WD3 | 320002230 |
| C5 | .0022UF | | 10% | 100V | 13606 | 225P22291WD3 | 320002220 |
| C6 | SAME AS C4 | | | | | | |
| C7 | SAME AS C4 | | | | | | |
| C8 | SAME AS C5 | | | | | | |
| C9 | SAME AS C4 | | | | | | |
| C10 | 1UF | | 10% | 35V | 05397 | T330A105K035AS | 310001051 |
| C11 | .047UF | .03UF | 10% | 100V | 13606 | 225P47391WD3 | 320004730 |
| C12 | SAME AS C11 | | | | | | |
| C13 | 1.0UF | Y5V TC | 20% | 50V | 72982 | 8131-050-651-105M | 330801050 |
| C14 | SAME AS C10 | | | | | | |
| C15 | .001UF | | 10% | 100V | 13606 | 225P10291WD3 | 320001020 |
| C16 | 20UF | | | 15V | 22650 | JA-5-20-15-8N | 301302060 |
| CR1 | D035 | 500MW | 00 | 20V | 12065 | 1N4148 | 560041480 |
| CR2 | SAME AS CR1 | | | | | | |
| CR3 | SAME AS CR1 | | | | | | |
| CR4 | SAME AS CR1 | | | | | | |
| CR5 | SAME AS CR1 | | | | | | |
| CR6 | SAME AS CR1 | | | | | | |
| CR7 | SAME AS CR1 | | | | | | |
| CR8 | SAME AS CR1 | | | | | | |
| CR9 | SAME AS CR1 | | | | | | |
| K1 | | | | 12V | ALLIED CON | RF-1A0000 | 604101300 |
| Q1 | TO92 | 1-5MA | 00 | 25D | 04713 | MPF103 2N5457 | 554001030 |
| Q2 | TO92 | 2-9MA | 00 | 400V | 04713 | MPF152 2N5461 | 555001520 |
| Q3 | TO92HSS | 310MW | 00 | 40V | 04713 | 2N3903 | 550039030 |
| Q4 | SAME AS Q3 | | | | | | |
| Q5 | TO5HNS | 1W | 00 | 65V | 49671 | 2N2102 | 550021020 |
| Q6 | TO5MSS | 5W | 00 | 65V | 49671 | 2N4036 | 552040360 |
| Q7 | SAME AS Q3 | | | | | | |
| Q8 | SAME AS Q3 | | | | | | |
| Q9 | SAME AS Q1 | | | | | | |
| Q10 | SAME AS Q1 | | | | | | |
| R1 | 5110- | 1/8W | 1% | | 19701 | MF5C | 220251111 |
| R2 | 162- | 1/8W | 1% | | 19701 | MF5C | 220216201 |
| R3 | SAME AS R2 | | | | | | |
| R4 | SAME AS R1 | | | | | | |
| R5 | 16.2K | 1/8W | 1% | | 19701 | MF5C | 220216221 |
| R6 | SAME AS R5 | | | | | | |
| R7 | 5K | 1/2W | 10% | 200V | HILIPOT | 62P5K | 232705026 |
| R8 | 22K | 1/4W | 10% | | 01121 | TYPE CB | 200102236 |
| R9 | 1M | 1/4W | 10% | | 01121 | TYPE CB | 200101056 |
| R10 | SAME AS R9 | | | | | | |
| R11 | 10K | 1/4W | 10% | | 01121 | TYPE CB | 200101036 |
| R12 | SAME AS R11 | | | | | | |
| R13 | SAME AS R11 | | | | | | |

Table 6–6 (cont)

| REFERENCE DESIGNATOR | DESCRIPTION | MFGR. | MFGR. PART NO. | N.E.C. PART NO. |
|---|---|---|---|---|
| R14 | SAME AS R11 | | | |
| R15 | 17.8K 1/8W 1% | 19701 | MF5C | 220217821 |
| R16 | 383K 1/8W 1% | 19701 | MF5C | 220238331 |
| R17 | 4.7K 1/4W 10% | 01121 | TYPE CB | 200104726 |
| R18 | 18K 1/4W 10% | 01121 | TYPE CB | 200101836 |
| R19 | 3.3K 1/4W 10% | 01121 | TYPE CB | 200103326 |
| R20 | SAME AS R8 | | | |
| R21 | SAME AS R17 | | | |
| R22 | SAME AS R15 | | | |
| R23 | SAME AS R16 | | | |
| R24 | SAME AS R17 | | | |
| R25 | SAME AS R18 | | | |
| R26 | SAME AS R19 | | | |
| R27 | 47K 1/4W 10% | 01121 | TYPE CB | 200104736 |
| R28 | SAME AS R8 | | | |
| R29 | 39- 1/2W 5% | 01121 | TYPE EB | 200203905 |
| R30 | SAME AS R29 | | | |
| R31 | SAME AS R19 | | | |
| R32 | 1.8K 1/4W 10% | 01121 | TYPE CB | 200101826 |
| R33 | 8.2K 1/4W 10% | 01121 | TYPE CB | 200108226 |
| R34 | SAME AS R17 | | | |
| R35 | SAME AS R11 | | | |
| R36 | SAME AS R19 | | | |
| R37 | SAME AS R19 | | | |
| R38 | SAME AS R17 | | | |
| R39 | 10K 1/8W 1% | 19701 | MF5C | 220210021 |
| R40 | 14.7K 1/8W 1% | 19701 | MF5C | 220214721 |
| R41 | SAME AS R39 | | | |
| R42 | 100K 1/4W 10% | 01121 | TYPE CB | 200101046 |
| R43 | SAME AS R42 | | | |
| R44 | SAME AS R39 | | | |
| R45 | 12.4K 1/8W 1% | 19701 | MF5C | 220212421 |
| R46 | SAME AS R39 | | | |
| R47 | SAME AS R39 | | | |
| R48 | SAME AS R39 | | | |
| R49 | SAME AS R7 | | | |
| R50 | SAME AS R1 | | | |
| R51 | SAME AS R7 | | | |
| RV1 | SILICON | 81071 | SV-1 | 565510000 |
| RV2 | SAME AS RV1 | | | |
| T1 | P20-30K S800-1200 AUDIO P | 80223 | S0-7P | 400300100 |
| T2 | SAME AS T1 | | | |
| U1 | 8PDIL 80MW 00 180 | 18324 | N5558V | 500055580 |
| U2 | SAME AS U1 | | | |
| U3 | SAME AS U1 | | | |
| U4 | SAME AS U1 | | | |
| U5 | SAME AS U1 | | | |

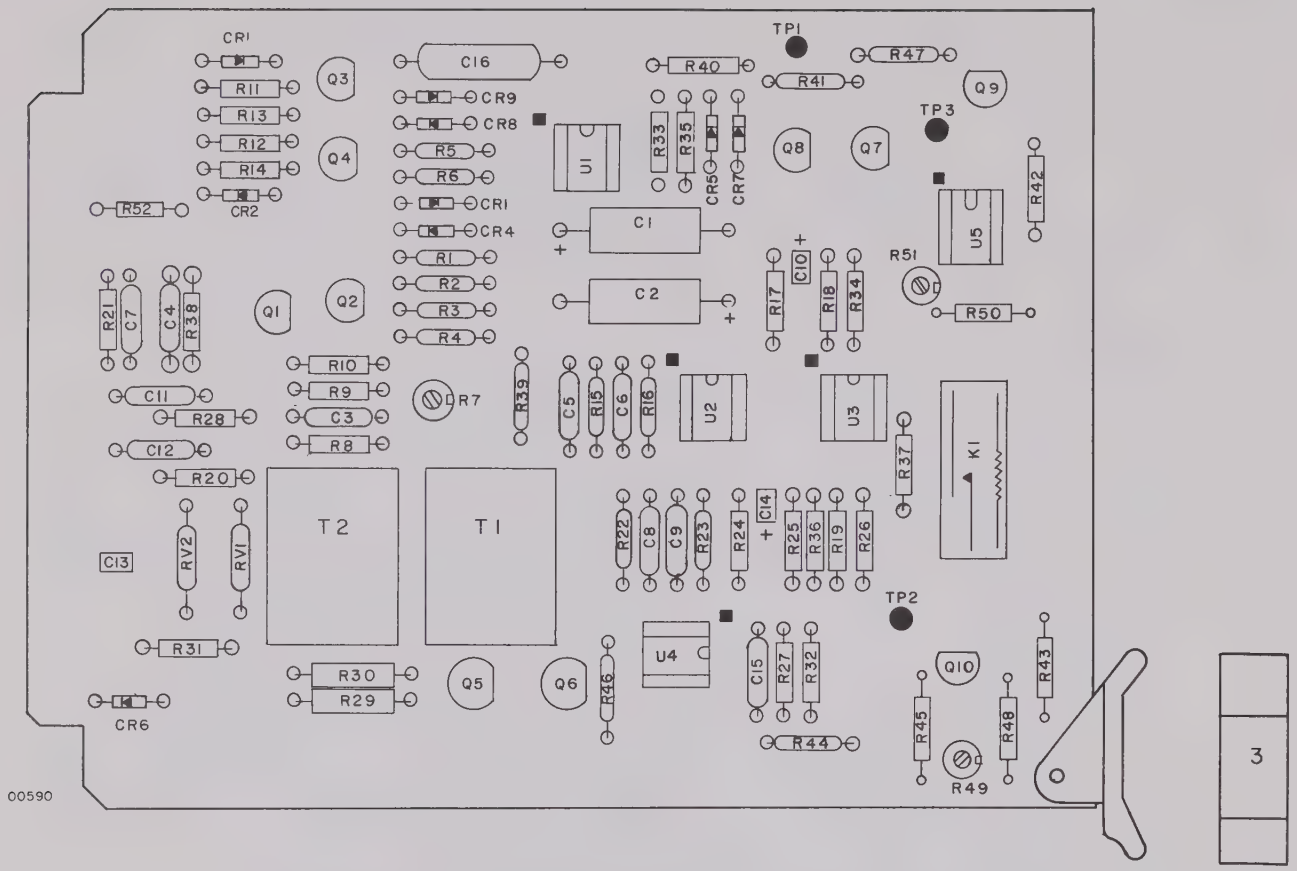



**Figure 6–4. TTS 2762, Main Input, Card 3 (96285) Component Location**

**Table 6–7. TTS 2762, Dual Selective Detector, Card 4 (96072) Parts List**

| REFERENCE DESIGNATOR | DESCRIPTION | MFGR. | MFGR. PART NO. | N.E.C. PART NO. |
|---|---|---|---|---|
| C1 | .01UF 10% 100V | 13606 | 225P10391WD3 | 320001030 |
| C2 | .01UF 1% 50V | 27735 | PC12-.01-50-1 | 322201030 |
| C3 | SAME AS C2 | | | |
| C4 | SAME AS C2 | | | |
| C5 | SAME AS C2 | | | |
| C6 | 1.0UF 35V TC 20% 50V | 72982 | 8131-050-651-105M | 330801050 |
| C7 | .1UF 10% 50V | 05397 | T330A104K050AS | 310001040 |
| C8 | SAME AS C7 | | | |
| C9 | SAME AS C1 | | | |
| C10 | SAME AS C2 | | | |
| C11 | SAME AS C2 | | | |
| C12 | SAME AS C2 | | | |
| C13 | SAME AS C2 | | | |
| C14 | SAME AS C6 | | | |
| C15 | SAME AS C7 | | | |
| C16 | SAME AS C7 | | | |

Table 6–7. (cont)

| REFERENCE DESIGNATOR | DESCRIPTION | MFGR. | MFGR. PART NO. | N.E.C. PART NO. |
|---|---|---|---|---|
| CR1 | DO35 500MW 00 20V | 12065 | 1N4148 | 560041480 |
| CR2 | SAME AS CR1 | | | |
| CR3 | SAME AS CR1 | | | |
| CR4 | SAME AS CR1 | | | |
| CR5 | SAME AS CR1 | | | |
| CR6 | SAME AS CR1 | | | |
| Q1 | TO92AFA 310MW 00 25V | 04713 | MPS6515 | 550065150 |
| Q2 | TO92AFA 310MW 00 40OV | 17803 | 2N3569 | 550035690 |
| Q3 | SAME AS Q1 | | | |
| Q4 | SAME AS Q2 | | | |
| R4 | 100K 1/4W 10% | 01121 | TYPE CB | 200101046 |
| R5 | 4420- 1/8W 1% | 19701 | MF5C | 220244211 |
| R6 | 7870- 1/8W 1% | 19701 | MF5C | 220278711 |
| R9 | 22.6K 1/8W 1% | 19701 | MF5C | 220222621 |
| R10 | SAME AS R9 | | | |
| R11 | SAME AS R4 | | | |
| R12 | SAME AS R6 | | | |
| R14 | SAME AS R5 | | | |
| R16 | 22.1K 1/8W 1% | 19701 | MF5C | 220222121 |
| R17 | SAME AS R16 | | | |
| R18 | 20K 1/2W 10% 200V | 73138 | 66WR | 232702030 |
| R19 | 100- 1/4W 10% | 01121 | TYPE CB | 200101016 |
| R20 | 1M 1/4W 10% | 01121 | TYPE CB | 200101056 |
| R21 | SAME AS R4 | | | |
| R22 | SAME AS R4 | | | |
| R23 | SAME AS R4 | | | |
| R24 | SAME AS R4 | | | |
| R25 | 220K 1/4W 10% | 01121 | TYPE CB | 200102246 |
| R26 | 10K 1/4W 10% | 01121 | TYPE CB | 200101036 |
| R27 | SAME AS R4 | | | |
| R28 | SAME AS R6 | | | |
| R30 | SAME AS R5 | | | |
| R32 | 17.4K 1/8W 1% | 19701 | MF5C | 220217421 |
| R33 | SAME AS R32 | | | |
| R34 | SAME AS R4 | | | |
| R35 | SAME AS R6 | | | |
| R37 | SAME AS R5 | | | |
| R38 | 16.9K 1/8W 1% | 19701 | MF5C | 220216921 |
| R39 | SAME AS R38 | | | |
| R41 | SAME AS R18 | | | |
| R42 | SAME AS R19 | | | |
| R43 | SAME AS R20 | | | |
| R44 | SAME AS R4 | | | |
| R45 | SAME AS R4 | | | |
| R46 | SAME AS R4 | | | |
| R47 | SAME AS R4 | | | |
| R48 | SAME AS R25 | | | |
| R49 | SAME AS R26 | | | |
| U1 | 8PDIL 80MW 00 180 | 18324 | N5558V | 500055580 |
| U2 | SAME AS U1 | | | |
| U3 | SAME AS U1 | | | |
| U4 | SAME AS U1 | | | |

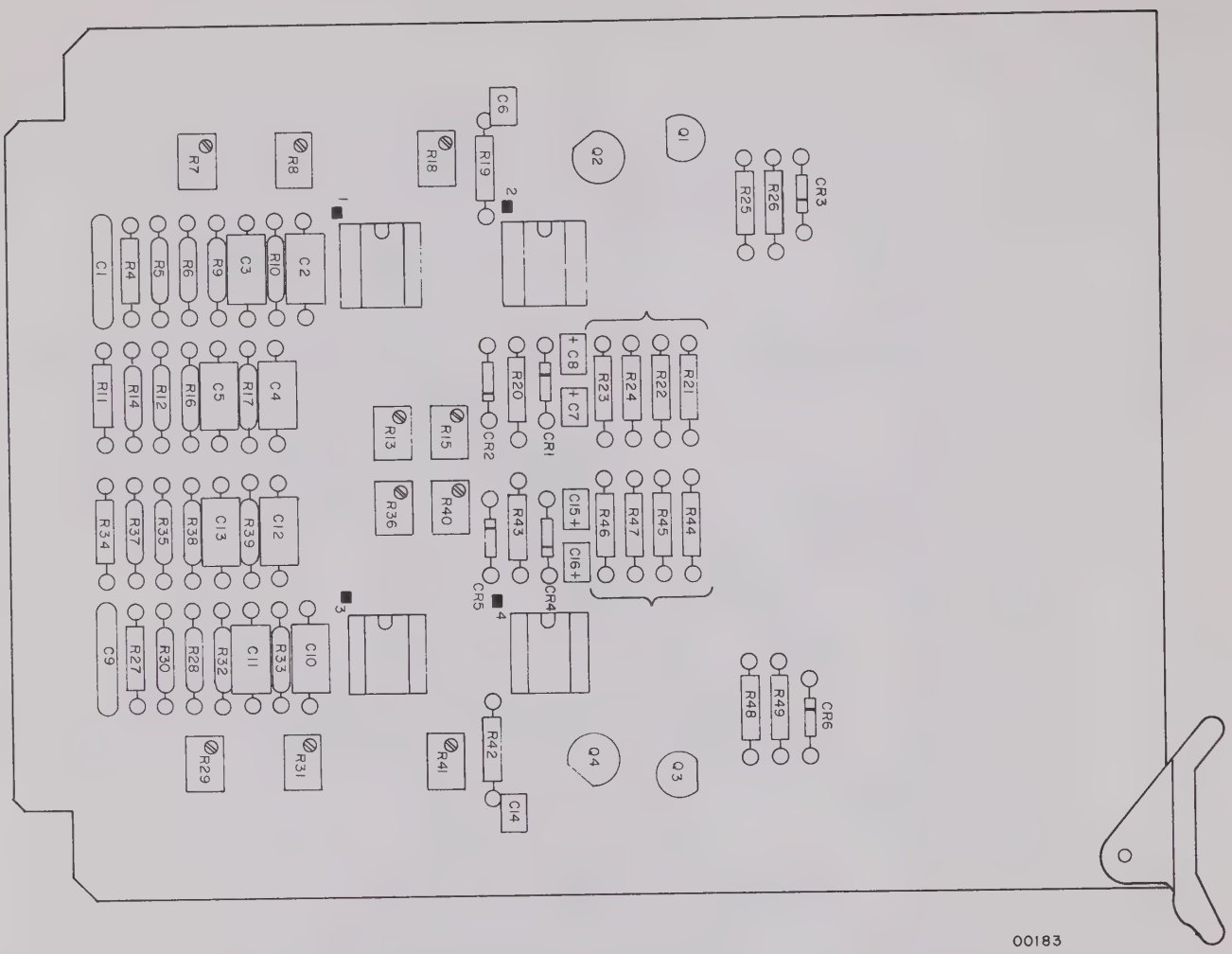



**Figure 6–5. TTS 2762, Dual Selective Detector, Cards 4,5 and 6 (96072), Component Location**

**Table 6–8. TTS 2762, Dual Selective Detector, Card 5 (96072) Parts List**

| REFERENCE DESIGNATOR | DESCRIPTION | MFGR. | MFGR. PART NO. | N.E.C. PART NO. |
|---|---|---|---|---|
| C1 | .01UF 10% 100V | 13606 | 225P10391WD3 | 320001030 |
| C2 | .01UF 1% 50V | 27735 | PC12-.01-50-1 | 322201030 |
| C3 | SAME AS C2 | | | |
| C4 | SAME AS C2 | | | |
| C5 | SAME AS C2 | | | |
| C6 | 1.0UF Y5V TC 20% 50V | 72982 | 8131-050-651-105M | 330801050 |
| C7 | .1UF 10% 50V | 05397 | T330A104K050AS | 310001040 |
| C8 | SAME AS C7 | | | |
| C9 | SAME AS C1 | | | |
| C10 | SAME AS C2 | | | |
| C11 | SAME AS C2 | | | |
| C12 | SAME AS C2 | | | |
| C13 | SAME AS C2 | | | |
| C14 | SAME AS C6 | | | |
| C15 | SAME AS C7 | | | |
| C16 | SAME AS C7 | | | |

Table 6–8. (cont)

| REFERENCE DESIGNATOR | DESCRIPTION | MFGR. | MFGR. PART NO. | N.E.C. PART NO. |
|---|---|---|---|---|
| CR1 | D035 500MW 00 20V | 12065 | 1N4148 | 5600041480 |
| CR2 | SAME AS CR1 | | | |
| CR3 | SAME AS CR1 | | | |
| CR4 | SAME AS CR1 | | | |
| CR5 | SAME AS CR1 | | | |
| CR6 | SAME AS CR1 | | | |
| Q1 | TO92AFA 310MW 00 25V | 04713 | MPS6515 | 550065150 |
| Q2 | TO92AFA 310MW 00 400V | 17803 | 2N3569 | 550035690 |
| Q3 | SAME AS Q1 | | | |
| Q4 | SAME AS Q2 | | | |
| R4 | 100K 1/4W 10% | 01121 | TYPE CB | 200101046 |
| R5 | 4420- 1/8W 1% | 19701 | MF5C | 220244211 |
| R6 | 7870- 1/8W 1% | 19701 | MF5C | 220278711 |
| R7 | 1K 1/2W 10% 200V | HILIPOT | 66WR1K | 232701023 |
| R8 | SAME AS R7 | | | |
| R9 | 14.3K 1/8W 1% | 19701 | MF5C | 220214321 |
| R10 | SAME AS R9 | | | |
| R11 | SAME AS R4 | | | |
| R12 | SAME AS R6 | | | |
| R13 | SAME AS R7 | | | |
| R14 | SAME AS R5 | | | |
| R15 | SAME AS R7 | | | |
| R16 | 13.7K 1/8W 1% | 19701 | MF5C | 220213721 |
| R17 | SAME AS R16 | | | |
| R18 | 20K 1/2W 10% 200V | 73138 | 66WR | 232702030 |
| R19 | 100- 1/4W 10% | 01121 | TYPE CB | 200101016 |
| R20 | 1M 1/4W 10% | 01121 | TYPE CB | 200101056 |
| R21 | SAME AS R4 | | | |
| R22 | SAME AS R4 | | | |
| R23 | SAME AS R4 | | | |
| R24 | SAME AS R4 | | | |
| R25 | 220K 1/4W 10% | 01121 | TYPE CB | 200102246 |
| R26 | 10K 1/4W 10% | 01121 | TYPE CB | 200101036 |
| R27 | SAME AS R4 | | | |
| R28 | SAME AS R6 | | | |
| R29 | SAME AS R7 | | | |
| R30 | SAME AS R5 | | | |
| R31 | SAME AS R7 | | | |
| R32 | 12.1K 1/8W 1% | 19701 | MF5C | 220212121 |
| R33 | SAME AS R32 | | | |
| R34 | SAME AS R4 | | | |
| R35 | SAME AS R6 | | | |
| R36 | SAME AS R7 | | | |
| R37 | SAME AS R5 | | | |
| R38 | 11.8K 1/8W 1% | 19701 | MF5C | 220211821 |
| R39 | SAME AS R38 | | | |
| R40 | SAME AS R7 | | | |
| R41 | SAME AS R18 | | | |
| R42 | SAME AS R19 | | | |
| R43 | SAME AS R20 | | | |
| R44 | SAME AS R4 | | | |
| R45 | SAME AS R4 | | | |

Table 6–8. (cont)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| R46 | SAME AS R4 | | | | | | |
| R47 | SAME AS R4 | | | | | | |
| R48 | SAME AS R25 | | | | | | |
| R49 | SAME AS R26 | | | | | | |
| U1 | 8PDIL | 80Mw | 00 | 180 | 18324 | N5558V | 500055580 |
| U2 | SAME AS U1 | | | | | | |
| U3 | SAME AS U1 | | | | | | |
| U4 | SAME AS U1 | | | | | | |

Table 6–9. TTS 2762, Dual Selective Detector, Card 6 (96072) Parts List

| REFERENCE DESIGNATOR | DESCRIPTION | | | | MFGR. | MFGR. PART NO. | N.E.C. PART NO. |
|---|---|---|---|---|---|---|---|
| C1 | .01UF | | 10% | 100V | 13606 | 225P10391WD3 | 320001030 |
| C2 | .01UF | | 1% | 50V | 27735 | PC12-.01-50-1 | 322201030 |
| C3 | SAME AS C2 | | | | | | |
| C4 | SAME AS C2 | | | | | | |
| C5 | SAME AS C2 | | | | | | |
| C6 | 1.0UF | Y5V TC | 20% | 50V | 72982 | 8131-050-651-105M | 330801050 |
| C7 | .1UF | | 10% | 50V | 05397 | T330A104K050AS | 310001040 |
| C8 | SAME AS C7 | | | | | | |
| C9 | SAME AS C1 | | | | | | |
| C10 | SAME AS C2 | | | | | | |
| C11 | SAME AS C2 | | | | | | |
| C12 | SAME AS C2 | | | | | | |
| C13 | SAME AS C2 | | | | | | |
| C14 | SAME AS C6 | | | | | | |
| C15 | SAME AS C7 | | | | | | |
| C16 | SAME AS C7 | | | | | | |
| CR1 | D035 | 500MW | 00 | 20V | 12065 | 1N4148 | 560041480 |
| CR2 | SAME AS CR1 | | | | | | |
| CR3 | SAME AS CR1 | | | | | | |
| CR4 | SAME AS CR1 | | | | | | |
| CR5 | SAME AS CR1 | | | | | | |
| CR6 | SAME AS CR1 | | | | | | |
| Q1 | TO92AFA | 310MW | 00 | 25V | 04713 | MPS6515 | 550065150 |
| Q2 | TO92AFA | 310MW | 00 | 400V | 17803 | 2N3569 | 550035690 |
| Q3 | SAME AS Q1 | | | | | | |
| Q4 | SAME AS Q2 | | | | | | |
| R4 | 100K | 1/4w | 10% | | 01121 | TYPE CB | 200101046 |
| R5 | 4420- | 1/8w | 1% | | 19701 | MF5C | 220244211 |
| R6 | 7870- | 1/8W | 1% | | 19701 | MF5C | 220278711 |
| R7 | 1K | 1/2w | 10% | 200V | HILIPOT | 66WR1K | 232701023 |
| R8 | SAME AS R7 | | | | | | |
| R9 | 10.5K | 1/8W | 1% | | 19701 | MF5C | 220210521 |
| R10 | SAME AS R9 | | | | | | |
| R11 | SAME AS R4 | | | | | | |
| R12 | SAME AS R6 | | | | | | |
| R13 | SAME AS R7 | | | | | | |
| R14 | SAME AS R5 | | | | | | |
| R15 | SAME AS R7 | | | | | | |
| R16 | 10.2K | 1/8W | 1% | | 19701 | MF5C | 220210221 |
| R17 | SAME AS R16 | | | | | | |
| R18 | 20K | 1/2W | 10% | 200V | 73138 | 66WR | 232702030 |

Table 6–9 (cont)

| REFERENCE DESIGNATOR | DESCRIPTION | | MFGR. | MFGR. PART NO. | N.E.C. PART NO. |
|---|---|---|---|---|---|
| R19 | 100 | 1/4W 10% | 01121 | TYPE CB | 200101016 |
| R20 | 1M | 1/4W 10% | 01121 | TYPE CB | 200101056 |
| R21 | SAME AS R4 | | | | |
| R22 | SAME AS R4 | | | | |
| R23 | SAME AS R4 | | | | |
| R24 | SAME AS R4 | | | | |
| R25 | 220K | 1/4W 10% | 01121 | TYPE CB | 200102246 |
| R26 | 10K | 1/4W 10% | 01121 | TYPE CB | 200101036 |
| R27 | SAME AS R4 | | | | |
| R28 | SAME AS R6 | | | | |
| R29 | SAME AS R7 | | | | |
| R30 | SAME AS R5 | | | | |
| R31 | SAME AS R7 | | | | |
| R32 | 9.31K | 1/8W 1% | 19701 | MF5C | 220293111 |
| R33 | SAME AS R32 | | | | |
| R34 | SAME AS R4 | | | | |
| R35 | SAME AS R6 | | | | |
| R36 | SAME AS R7 | | | | |
| R37 | SAME AS R5 | | | | |
| R38 | 8.87K | 1/8W 1% | 19701 | MF5C | 220288711 |
| R39 | SAME AS R38 | | | | |
| R40 | SAME AS R7 | | | | |
| R41 | SAME AS R18 | | | | |
| R42 | SAME AS R19 | | | | |
| R43 | SAME AS R20 | | | | |
| R44 | SAME AS R4 | | | | |
| R45 | SAME AS R4 | | | | |
| R46 | SAME AS R4 | | | | |
| R47 | SAME AS R4 | | | | |
| R48 | SAME AS R25 | | | | |
| R49 | SAME AS R26 | | | | |
| U1 | 8PDIL | 80MW 00 180 | 18324 | N5558V | 500055580 |
| U2 | SAME AS U1 | | | | |
| U3 | SAME AS U1 | | | | |
| U4 | SAME AS U1 | | | | |

Table 6–10. TTS 2762, Decoder, Card 7 (95874) Parts List

| REFERENCE DESIGNATOR | DESCRIPTION | | MFGR. | MFGR. PART NO. | N.E.C. PART NO. |
|---|---|---|---|---|---|
| CAR7 | PC BD | | | | 970295874 |
| R1 | 2.2K | 1/4W 10% | 01121 | TYPE CB | 200102226 |
| R2 | SAME AS R1 | | | | |
| R3 | SAME AS R1 | | | | |
| R4 | SAME AS R1 | | | | |
| R5 | SAME AS R1 | | | | |
| R6 | SAME AS R1 | | | | |
| R7 | 10K | 1/4W 10% | 01121 | TYPE CB | 200101036 |
| U1 | 14DILP | 00 | 04713 | MC9718P | 512097180 |
| U2 | 14DILP | 00 | 18324 | SP377A | 510003770 |
| U3 | SAME AS U2 | | | | |
| U4 | SAME AS U2 | | | | |
| U5 | SAME AS U2 | | | | |

Table 6–10. (cont)

| | | | | | |
|---|---|---|---|---|---|
| U6 | SAME AS U2 | | | | |
| U7 | 14DILP | 00 | 18324 | SP384A | 510003840 |
| U8 | SAME AS U7 | | | | |
| U9 | SAME AS U7 | | | | |
| U10 | SAME AS U7 | | | | |
| U11 | 14DILP | 00 | 01295 | SN7430N | 510074300 |
| U12 | 14DILP | 00 | 01295 | SN7420N | 510074200 |
| U13 | 14DILP | 00 | 01295 | SN7400N | 510074000 |
| U14 | 14DILP | 00 | 18324 | SP314A | 510003140 |
| U15 | 14PDIL | | TI | SN7403N | 510074030 |

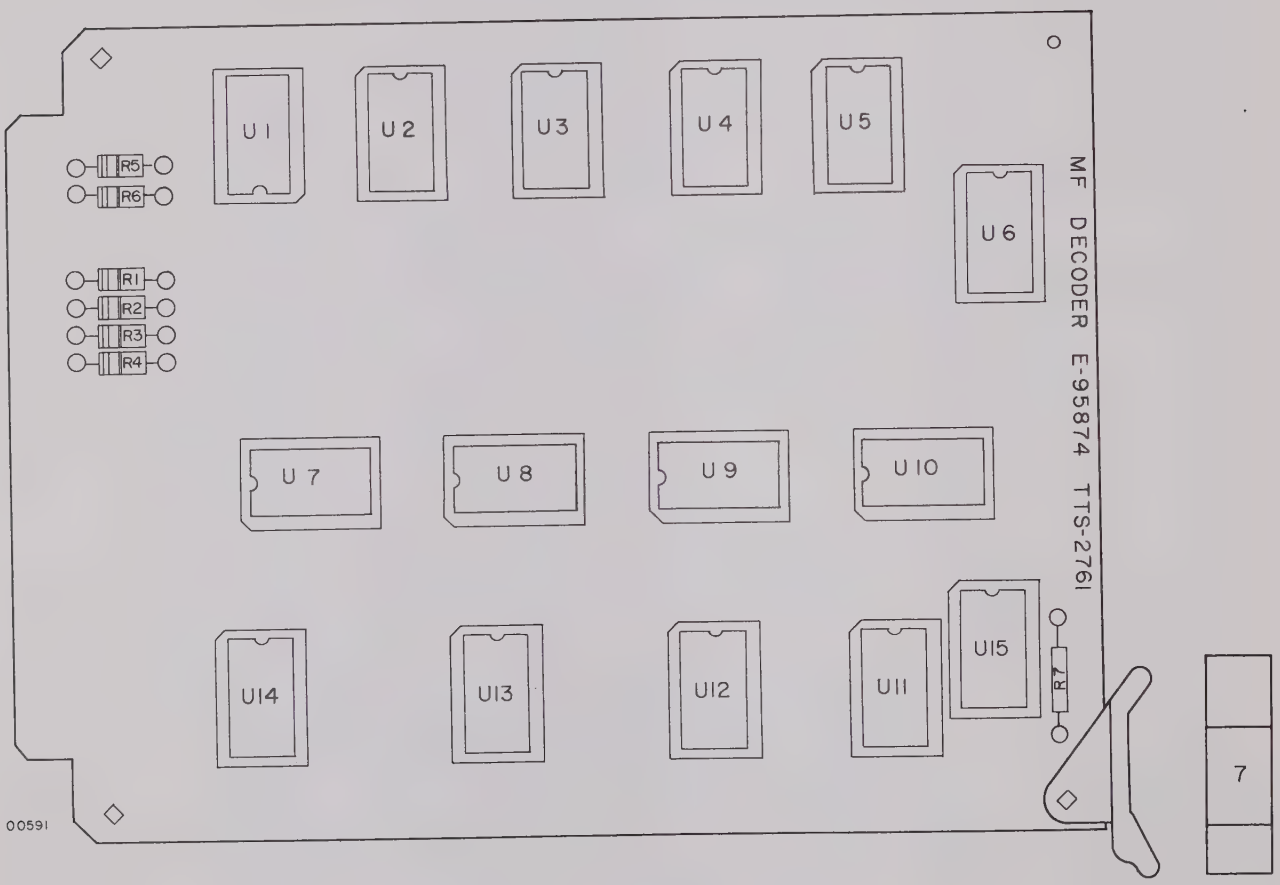



Figure 6–6. TTS 2762, MF Decoder, Card 7 (95874), Component Location

## Table 6—11. TTS 2762, MF Register, Card 8 (96280) Parts List

| REFERENCE DESIGNATOR | DESCRIPTION | | | | MFGR. | MFGR. PART NO. | N.E.C. PART NO. |
|---|---|---|---|---|---|---|---|
| C1 | 2.2UF | | 10% | 35V | 05397 | T330A225K035AS | 310002250 |
| C2 | 1000PF | Z5RTC | 10% | 1KV | 71590 | DD-102 | 330001020 |
| C3 | 1UF | | 10% | 35V | 05397 | T330A105K035AS | 310001051 |
| C4 | 270PF | Z5FTC | 10% | 1KV | 71590 | DD-271 | 330002710 |
| C5 | SAME AS C2 | | | | | | |
| C6 | SAME AS C2 | | | | | | |
| C7 | SAME AS C2 | | | | | | |
| C8 | 4.7UF | | 10% | 50V | 05397 | T330C475K050AS | 310004750 |
| C9 | 10UF | | 10% | 10V | 05397 | T330A106K010AS | 310001060 |
| C10 | SAME AS C8 | | | | | | |
| C11 | SAME AS C8 | | | | | | |
| CR1 | DO35 | 500MW | 00 | 20V | 12065 | 1N4148 | 560041480 |
| CR2 | SAME AS CR1 | | | | | | |
| CR3 | SAME AS CR1 | | | | | | |
| Q6 | TO92HSS | 310MW | 00 | 40V | 04713 | 2N3903 | 550039030 |
| Q11 | SAME AS Q6 | | | | | | |
| Q12 | SAME AS Q6 | | | | | | |
| Q13 | SAME AS Q6 | | | | | | |
| R1 | 5.62K | 1/8W | 1% | | 19701 | MF5C | 220256211 |
| R2 | 10K | 1/4W | 10% | | 01121 | TYPE CB | 200101036 |
| R3 | 8250- | 1/8W | 1% | | 19701 | MF5C | 220282511 |
| R4 | 750- | 1/8W | 1% | | 19701 | MF5C | 220275001 |
| R5 | 28.7K | 1/8W | 1% | | 19701 | MF5C | 220228721 |
| R6 | 31.6K | 1/8W | 1% | | 19701 | MF5C | 220231621 |
| R7 | 2610- | 1/8W | 1% | | 19701 | MF5C | 220226111 |
| R8 | 1960- | 1/8W | 1% | | 19701 | MF5C | 220219611 |
| R9 | SAME AS R2 | | | | | | |
| R10 | SAME AS R2 | | | | | | |
| R11 | 47K | 1/4W | 10% | | 01121 | TYPE CB | 200104736 |
| R12 | 5.6K | 1/4W | 10% | | 01121 | TYPE CB | 200105626 |
| R13 | 4.7K | 1/4W | 10% | | 01121 | TYPE CB | 200104726 |
| R14 | | 1/8W | 1% | | 19701 | MF5C | 220200000 |
| R15 | 1330- | 1/8W | 1% | | 19701 | MF5C | 220213311 |
| R16 | 2150- | 1/8W | 1% | | 19701 | MF5C | 220221511 |
| R17 | 1.2K | 1/4W | 10% | | 01121 | TYPE CB | 200101226 |
| R18 | 22K | 1/4W | 10% | | 01121 | TYPE CB | 200102236 |
| R19 | 51.1K | 1/8W | 1% | | 19701 | MF5C | 220251121 |
| R20 | 50K | 1/2W | 10% | 200V | HILIPOT | 62P50K | 232705036 |
| R21 | 71.5K | 1/8W | 1% | | 19701 | MF5C | 220271521 |
| R22 | SAME AS R2 | | | | | | |
| R23 | 1K | 1/4W | 10% | | 01121 | TYPE CB | 200101026 |
| R24 | SAME AS R2 | | | | | | |
| R25 | SAME AS R18 | | | | | | |
| R26 | SAME AS R23 | | | | | | |
| R27 | SAME AS R18 | | | | | | |
| R28 | 2.7K | 1/4W | 10% | | 01121 | TYPE CB | 200102726 |
| R29 | SAME AS R13 | | | | | | |
| R30 | SAME AS R13 | | | | | | |
| R31 | 15.8K | 1/8W | 1% | | 19701 | MF5C | 220215821 |
| R32 | 19.1K | 1/8W | 1% | | 19701 | MF5C | 220219121 |

Table 6–11. (cont)

| REFERENCE DESIGNATOR | DESCRIPTION | | MFGR. | MFGR. PART NO. | N.E.C. PART NO. |
|---|---|---|---|---|---|
| R33 | SAME AS R2 | | | | |
| U1 | 14DILP | 00 | 49671 | CA3045 | 500030450 |
| U2 | 14DILP | 00 | 01295 | SN7472N | 510074720 |
| U3 | 14DILP | 00 | 18324 | SP314A | 510003140 |
| U4 | 14DILP | 00 | 01295 | SN7400N | 510074000 |
| U5 | 14DILP | 00 | 01295 | SN7474N | 510074740 |
| U6 | SAME AS U5 | | | | |
| U7 | SAME AS U1 | | | | |
| U8 | 14DILP | 00 | 01295 | SN7401N | 510074010 |
| U9 | 16DILP | | TI | SN74123N | 510074123 |
| U10 | SAME AS U8 | | | | |

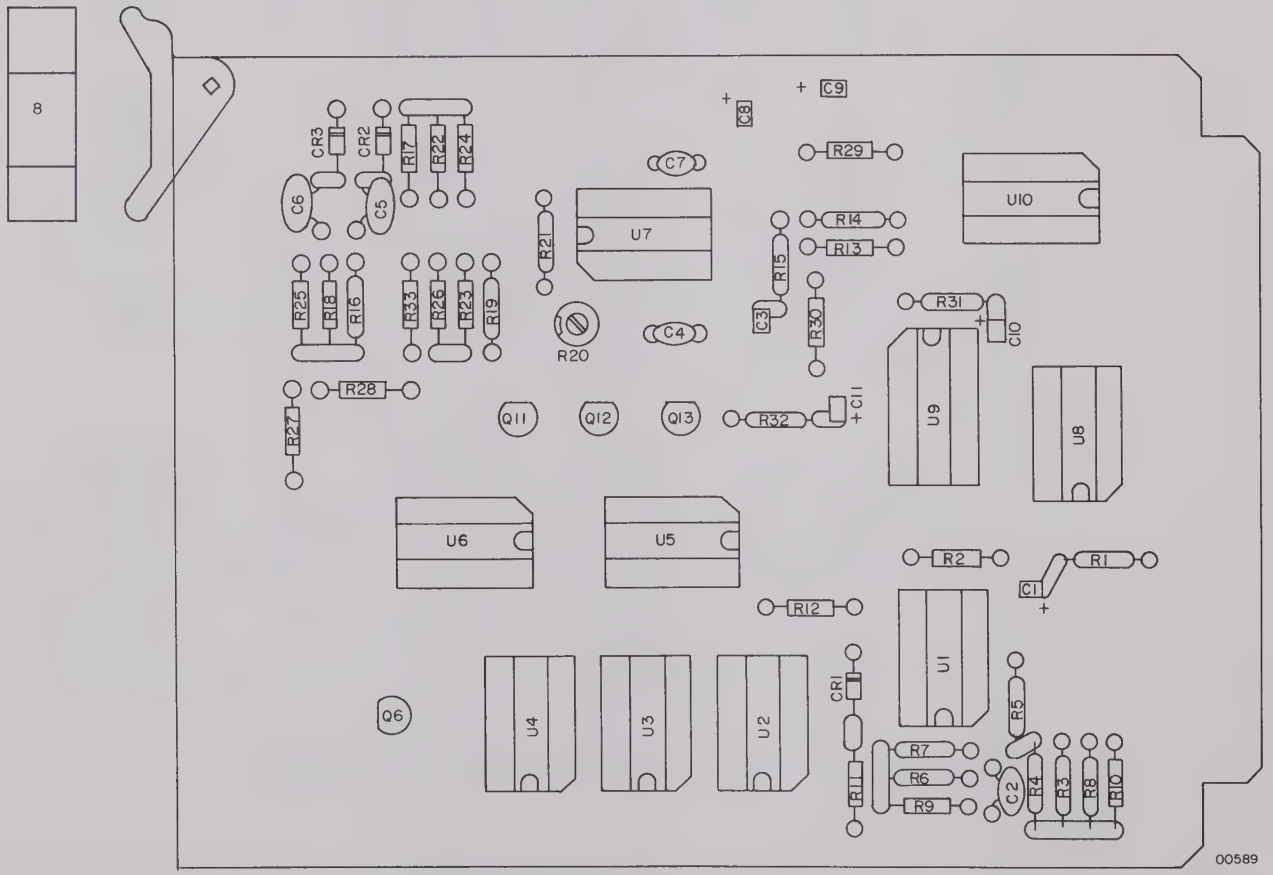



Figure 6–7. TTS 2762, MF Register, Card 8 (96280) Component Location

**Table 6–12. TTS 2762, Buffer, Card 9 (96281) Parts List**

| REFERENCE DESIGNATOR | DESCRIPTION | | | | MFGR. | MFGR. PART NO. | N.E.C. PART NO. |
|---|---|---|---|---|---|---|---|
| C1 | 22UF | | 10% | 6V | 05397 | T330A226K006AS | 310002260 |
| CR1 | DO35 | 500MW | 00 | 20V | 12065 | 1N4148 | 560041480 |
| K1 | | | | 6V | 04221 | 181-12A100 | 604104800 |
| Q1 | TO92MSS | 310MW | 00 | 40V | 04713 | 2N3905 | 552039050 |
| R1 | 390- | 1/4W | 10% | | 01121 | TYPE CB | 200103916 |
| R2 | 10K | 1/4W | 10% | | 01121 | TYPE CB | 200101036 |
| R3 | SAME AS R2 | | | | | | |
| R4 | SAME AS R2 | | | | | | |
| R5 | SAME AS R2 | | | | | | |
| R6 | SAME AS R2 | | | | | | |
| R7 | SAME AS R2 | | | | | | |
| R8 | 1.8K | 1/4W | 10% | | 01121 | TYPE CB | 200101826 |
| R9 | 2.7K | 1/4W | 10% | | 01121 | TYPE CB | 200102726 |
| R10 | 4.7K | 1/4W | 10% | | 01121 | TYPE CB | 200104726 |
| R11 | SAME AS R10 | | | | | | |
| R12 | 1K | 1/4W | 10% | | 01121 | TYPE CB | 200101026 |
| U1 | 14DILP | | 00 | | 01295 | SN7400N | 510074000 |
| U2 | SAME AS U1 | | | | | | |
| U3 | SAME AS U1 | | | | | | |
| U4 | DILP | | 00 | | 01295 | SN7407N14P | 510074070 |
| U5 | 14DILP | | 00 | | 01295 | SN7406N14P | 510074060 |
| U6 | SAME AS U5 | | | | | | |
| U7 | DILP | | 00 | | 01295 | SN7404N14P | 510074040 |
| U8 | 14DILP | | 00 | | 18324 | SP384A | 510003840 |
| U9 | SAME AS U8 | | | | | | |

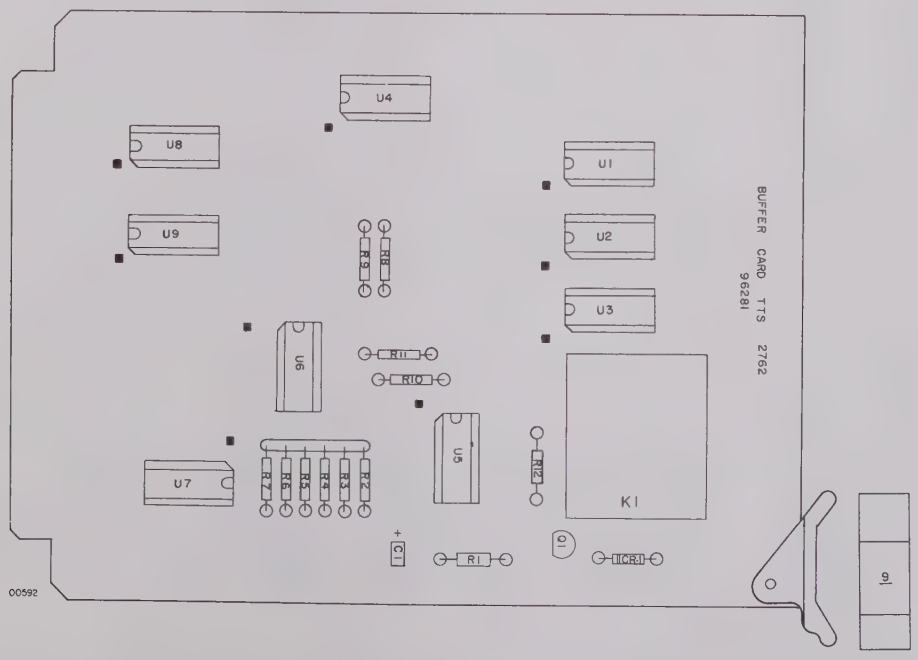



**Figure 6–8. TTS 2762, Buffer, Card 9 (96281) Component Location**

## Table 6—13. TTS 2762, T—R/E/M DC Input, Card 10 (96073) Parts Lsit

| REFERENCE DESIGNATOR | DESCRIPTION | MFGR. | MFGR. PART NO. | N.E.C. PART NO. |
|---|---|---|---|---|
| C1 | .015UF 10% 100V | 13606 | 225P15391WD3 | 320001530 |
| C2 | SAME AS C1 | | | |
| C3 | | | | 320001036 |
| C4 | SAME AS C3 | | | |
| C5 | 1UF 10% 35V | 05397 | T330A105K035AS | 310001051 |
| C6 | .1UF 10% 50V | 05397 | T330A104K050AS | 310001040 |
| C7 | SAME AS C3 | | | |
| C8 | 4.7UF 10% 50V | 05397 | T330C475K050AS | 310004750 |
| C9 | 6.8UF 10% 20V | 05397 | T330A685K020AS | 310006850 |
| C10 | .27UF 10% 35V | 05397 | T330A274K035AS | 310002740 |
| C11 | SAME AS C5 | | | |
| C12 | SAME AS C8 | | | |
| C13 | .01UF 10% 100V | 13606 | 225P10391WD3 | 320001030 |
| C14 | SAME AS C13 | | | |
| C15 | 15UF 10% 10V | 05397 | T330A156K010AS | 310001560 |
| C16 | 8.2UF 10% 15V | 05397 | T330A825K015AS | 310008250 |
| C17 | SAME AS C16 | | | |
| C18 | 22UF 10% 6V | 05397 | T330A226K006AS | 310002260 |
| CR1 | D035 500MW 00 20V | 12065 | 1N4148 | 560041480 |
| CR2 | SAME AS CR1 | | | |
| CR3 | SAME AS CR1 | | | |
| CR4 | SAME AS CR1 | | | |
| CR5 | SAME AS CR1 | | | |
| CR6 | SAME AS CR1 | | | |
| CR7 | SAME AS CR1 | | | |
| CR8 | SAME AS CR1 | | | |
| CR9 | SAME AS CR1 | | | |
| CR10 | SAME AS CR1 | | | |
| CR11 | SAME AS CR1 | | | |
| CR12 | SAME AS CR1 | | | |
| CR13 | SAME AS CR1 | | | |
| CR14 | SAME AS CR1 | | | |
| CR15 | SAME AS CR1 | | | |
| CR16 | SAME AS CR1 | | | |
| CR17 | SAME AS CR1 | | | |
| CR18 | SAME AS CR1 | | | |
| Q1 | TO92AFA 310MW 00 25V | 04713 | MPS6515 | 550065150 |
| Q2 | SAME AS Q1 | | | |
| Q3 | TO92AFA 310MW 00 4V | 04713 | MPS6518 | 550065180 |
| Q4 | SAME AS Q3 | | | |
| Q5 | SAME AS Q1 | | | |
| Q6 | SAME AS Q3 | | | |
| Q7 | SAME AS Q1 | | | |
| Q8 | SAME AS Q1 | | | |
| Q9 | SAME AS Q1 | | | |
| R1 | 470K 1/4W 10% | 01121 | TYPE CB | 200104746 |
| R2 | SAME AS R1 | | | |
| R3 | 10K 1/4W 10% | 01121 | TYPE CB | 200101036 |
| R4 | 3320- 1/8W 1% | 19701 | MF5C | 220233211 |
| R5 | 287K 1/8W 1% | ELECTRA | MF5C | 220228731 |

Table 6—13. (cont)

| REFERENCE DESIGNATOR | DESCRIPTION | MFGR. | MFGR. PART NO. | N.E.C. PART NO. |
|---|---|---|---|---|
| R6 | SAME AS R5 | | | |
| R7 | 100K 1/4W 10% | 01121 | TYPE CB | 200101046 |
| R8 | SAME AS R4 | | | |
| R9 | 9090- 1/8W 1% | 19701 | MF5C | 220290911 |
| R10 | SAME AS R3 | | | |
| R11 | 220K 1/4W 10% | 01121 | TYPE CB | 200102246 |
| R12 | SAME AS R11 | | | |
| R13 | 1M 1/4W 10% | 01121 | TYPE CB | 200101056 |
| R14 | 4.7M 1/4W 10% | 01121 | TYPE CB | 200104756 |
| R15 | SAME AS R7 | | | |
| R16 | SAME AS R7 | | | |
| R17 | SAME AS R3 | | | |
| R18 | SAME AS R7 | | | |
| R19 | SAME AS R3 | | | |
| R20 | SAME AS R11 | | | |
| R21 | SAME AS R7 | | | |
| R22 | SAME AS R3 | | | |
| R23 | SAME AS R3 | | | |
| R24 | SAME AS R3 | | | |
| R25 | 82- 1/4W 10% | 01121 | TYPE CB | 200108206 |
| R26 | 5.6K 1/4W 10% | 01121 | TYPE CB | 200105626 |
| R27 | 33K 1/4W 10% | 01121 | TYPE CB | 200103336 |
| R28 | 59K 1/8W 1% | ELECTRA | MF5C | 220259021 |
| R29 | 82K 1/4W 10% | 01121 | TYPE CB | 200108236 |
| R30 | 158K 1/8W 1% | 19701 | MF5C | 220215831 |
| R31 | 267K 1/8W 1% | ELECTRA | MF5C | 220226731 |
| R32 | 27K 1/4W 10% | 01121 | TYPE CB | 200102736 |
| R33 | 150K 1/4W 5% | 01121 | TYPE CB | 200101545 |
| R34 | 261K 1/8W 1% | ELECTRA | MF5C | 220226131 |
| R35 | 133K 1/8W 1% | 19701 | MF5C | 220213331 |
| R36 | SAME AS R3 | | | |
| R37 | 2.2K 1/4W 10% | 01121 | TYPE CB | 200102226 |
| R38 | SAME AS R3 | | | |
| R40 | 19.1K 1/8W 1% | 19701 | MF5C | 220219121 |
| R41 | SAME AS R3 | | | |
| R42 | SAME AS R7 | | | |
| R43 | SAME AS R32 | | | |
| R44 | 180K 1/4W 10% | 01121 | TYPE CB | 200101846 |
| R45 | SAME AS R25 | | | |
| R46 | 237K 1/8W 1% | 19701 | MF5C | 220223731 |
| R47 | 100K 1/8W 1% | 19701 | MF5C | 220210031 |
| R48 | SAME AS R47 | | | |
| R49 | 7500- 1/8W 1% | 19701 | MF5C | 220275011 |
| R50 | SAME AS R7 | | | |
| R51 | SAME AS R7 | | | |
| R52 | SAME AS R32 | | | |
| R53 | SAME AS R3 | | | |
| R54 | SAME AS R3 | | | |
| R55 | 3.3K 1/4W 10% | 01121 | TYPE CB | 200103326 |
| R56 | 15.8K 1/8W 1% | 19701 | MF5C | 220215821 |
| R57 | SAME AS R3 | | | |
| R58 | SAME AS R7 | | | |
| R59 | SAME AS R3 | | | |
| R60 | 150- 1/4W 10% | 01121 | TYPE CB | 200101516 |

Table 6–13 (cont)

| REFERENCE DESIGNATOR | DESCRIPTION | MFGR. | MFGR. PART NO. | N.E.C. PART NO. |
|---|---|---|---|---|
| R61 | 47K 1/4W 10% | 01121 | TYPE CB | 200104736 |
| R62 | 68- 1/4W 10% | 01121 | TYPE CB | 200106806 |
| R63 | 121K 1/8W 1% | 19701 | MF5C | 220212131 |
| R64 | 1K 1/4W 10% | 01121 | TYPE CB | 200101026 |
| R65 | 3.9K 1/4W 10% | 01121 | TYPE CB | 200103926 |
| R66 | SAME AS R65 | | | |
| R67 | 464- 1/8W 1% | 19701 | MF5C | 220246401 |
| R68 | SAME AS R55 | | | |
| R69 | SAME AS R37 | | | |
| R70 | SAME AS R65 | | | |
| R71 | SAME AS R37 | | | |
| R72 | SAME AS R3 | | | |
| R73 | SAME AS R3 | | | |
| R74 | 4.7K 1/4W 10% | 01121 | TYPE CB | 200104726 |
| R75 | 12K 1/4W 10% | 01121 | TYPE CB | 200101236 |
| R76 | SAME AS R74 | | | |
| RV1 | SILICON | 81071 | SV-1 | 565510000 |
| RV2 | SAME AS RV1 | | | |
| RV3 | SAME AS RV1 | | | |
| U1 | 8PDIL 80MW 00 180 | 18324 | N5558V | 500055580 |
| U2 | SAME AS U1 | | | |
| U3 | SAME AS U1 | | | |
| U4 | SAME AS U1 | | | |
| U5 | 14DILP 00 | 49671 | CA3045 | 500030450 |
| U6 | 16DILP | TI | SN74123N | 510074123 |
| U7 | SAME AS U5 | | | |
| U8 | SAME AS U1 | | | |
| U9 | 14DILP 00 | 01295 | SN7410N | 510074100 |
| U10 | 14DILP 00 | 01295 | SN7493N | 510074930 |
| U11 | 14PDIL | TI | SN7425N | 510074250 |
| U12 | 14DILP 00 | 01295 | SN7401N | 510074010 |
| U13 | SAME AS U5 | | | |
| U14 | SAME AS U12 | | | |

Table 6–14. TTS 2762, Interconnection Board, Card 11 (96106) Parts List

| REFERENCE DESIGNATOR | DESCRIPTION | MFGR. | MFGR. PART NO. | N.E.C. PART NO. |
|---|---|---|---|---|
| CR1 | D041 00 200V | 12065 | 1N4003 | 560040030 |
| CR2 | SAME AS CR1 | | | |
| F1 | 1/8A | LITTELFUSE | 275.125 | 863200900 |
| J1 | 5A 00 600V | 02660 | 225-22223-110 | 651701300 |
| J2 | SAME AS J1 | | | |
| J3 | SAME AS J1 | | | |
| J4 | SAME AS J1 | | | |
| J5 | SAME AS J1 | | | |
| J6 | SAME AS J1 | | | |
| J7 | SAME AS J1 | | | |
| J8 | SAME AS J1 | | | |
| J9 | SAME AS J1 | | | |
| J10 | SAME AS J1 | | | |
| R1 | 47- 1/4W 10% | 01121 | TYPE CB | 200104706 |

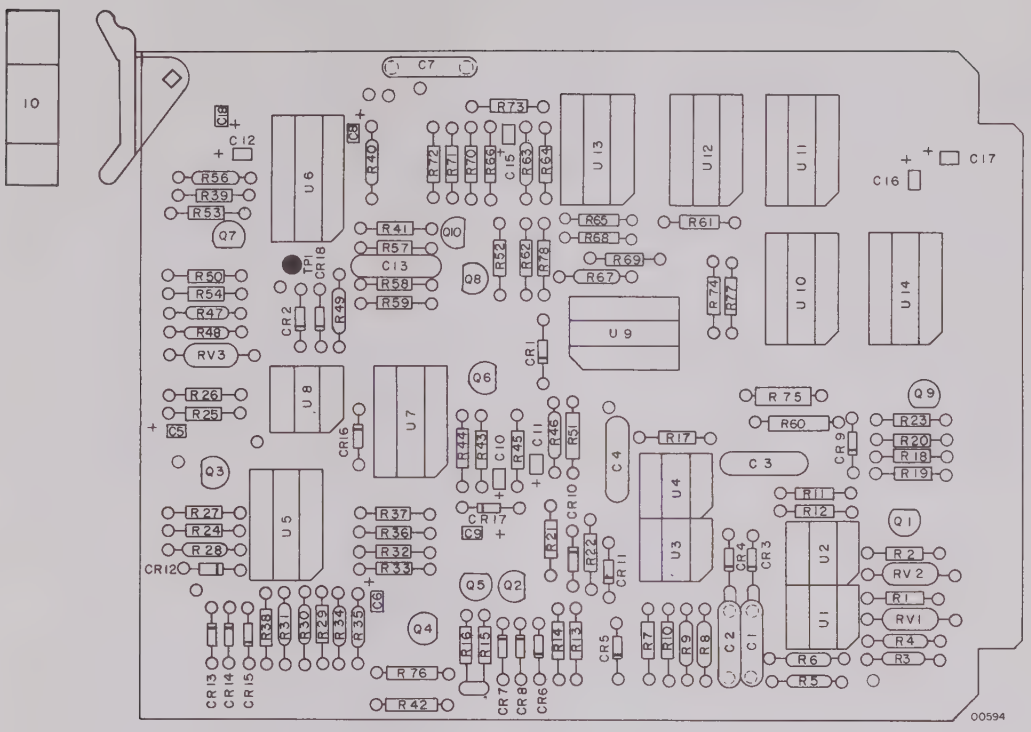



**Figure 6–9. TTS 2762, T–R/E/M DC Input, Card 10 (96073) Component Location**

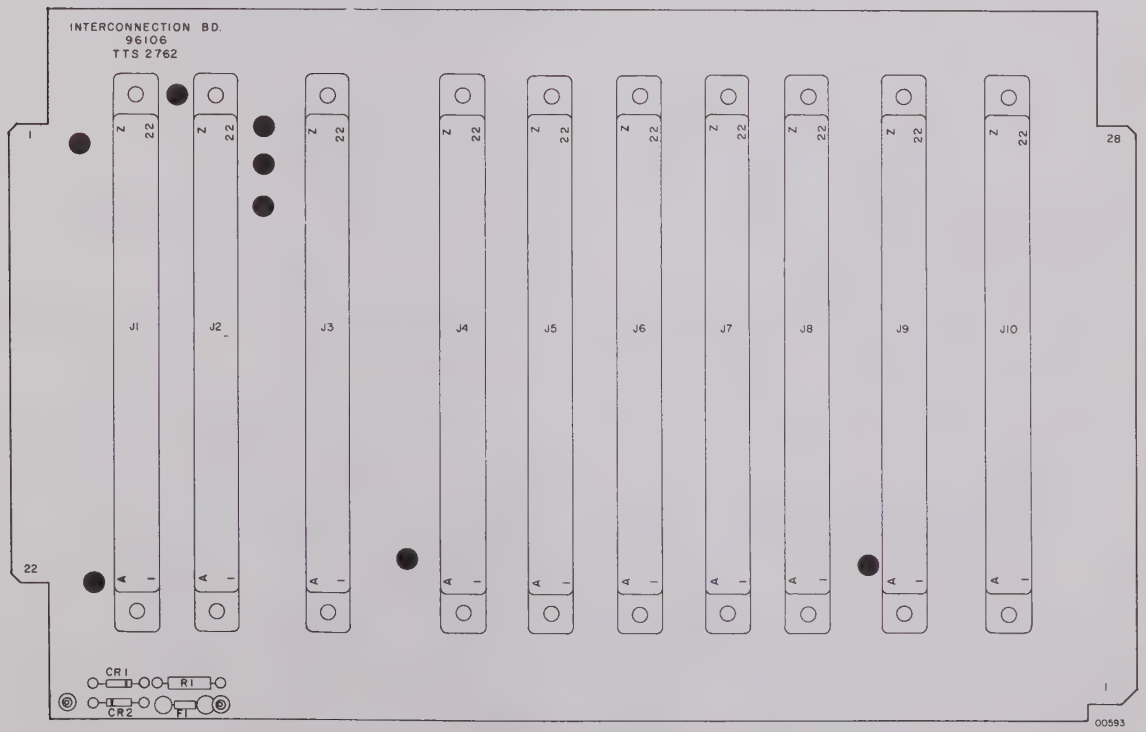



**Figure 6–10. TTS 2762, Interconnection Board, Card 11 (96106), Component Location**

Table 6–15. TTS 2762, Code Lamp Board, PC1 (95935) Parts List

| REFERENCE DESIGNATOR | DESCRIPTION | MFGR. | MFGR. PART NO. | N.E.C. PART NO. |
|---|---|---|---|---|
| DS1 | LED 75MA 1.6V | LITRONIX | RED-LIT2 | 564500100 |
| DS2 | SAME AS DS1 | | | |
| DS3 | SAME AS DS1 | | | |
| DS4 | SAME AS DS1 | | | |
| DS5 | SAME AS DS1 | | | |
| DS6 | SAME AS DS1 | | | |
| R1 | 100- 1/4W 10% | 01121 | TYPE CB | 200101016 |
| R2 | SAME AS R1 | | | |
| R3 | SAME AS R1 | | | |
| R4 | SAME AS R1 | | | |
| R5 | SAME AS R1 | | | |
| R6 | SAME AS R1 | | | |

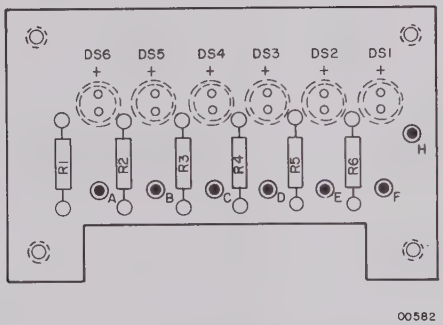



Figure 6–11. TTS 2762, Code Lamp Board PC1 (95935) Component Location

Table 6–16. TTS 2762, Supervision Lamp Board, PC2 (96053) Parts List

| REFERENCE DESIGNATOR | DESCRIPTION | MFGR. | MFGR. PART NO. | N.E.C. PART NO. |
|---|---|---|---|---|
| OS1 | LED 75MA 1.6V | LITRONIX | RED-LIT2 | 564500100 |
| OS2 | SAME AS OS1 | | | |
| OS3 | SAME AS OS1 | | | |
| OS4 | SAME AS OS1 | | | |
| R1 | 100- 1/4W 10% | 01121 | TYPE CB | 200101016 |
| R2 | SAME AS R1 | | | |
| R3 | SAME AS R1 | | | |
| R4 | SAME AS R1 | | | |

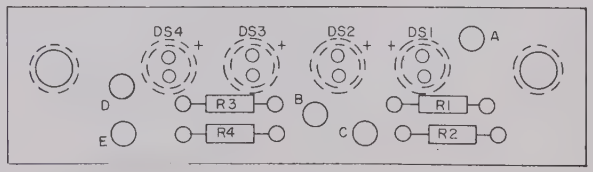



Figure 6–12. TTS 2762, Supervision Lamp Board, PC2 (96053), Component Location

**Table 6–17. TTS 2762, Frequency Lamp Board, PC3 (95937) Parts List**

| REFERENCE DESIGNATOR | DESCRIPTION | MFGR. | MFGR. PART NO. | N.E.C. PART NO. |
|---|---|---|---|---|
| DS1 | LED 75MA 1.6V | LITRONIX | RED-LIT2 | 564500100 |
| DS2 | SAME AS DS1 | | | |
| DS3 | SAME AS DS1 | | | |
| DS4 | SAME AS DS1 | | | |
| DS5 | SAME AS DS1 | | | |
| DS6 | SAME AS DS1 | | | |
| R1 | 100- 1/4W 10% | 01121 | TYPE CB | 200101016 |
| R2 | SAME AS R1 | | | |
| R3 | SAME AS R1 | | | |
| R4 | SAME AS R1 | | | |
| R5 | SAME AS R1 | | | |
| R6 | SAME AS R1 | | | |

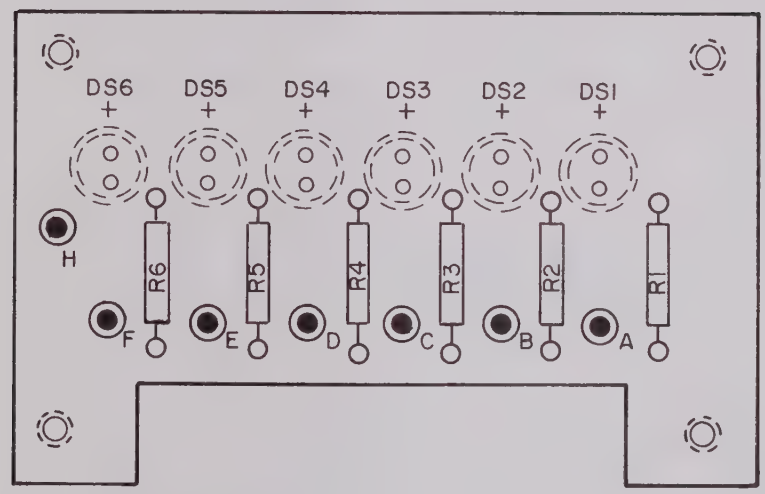



**Figure 6–13. TTS 2762, Frequency Lamp Board PC3 (95937), Component Location**

Table 6—18. TTS 2762, Termination Board, PC4 (95932) Parts List

| REFERENCE DESIGNATOR | DESCRIPTION | MFGR. | MFGR. PART NO. | N.E.C. PART NO. |
|---|---|---|---|---|
| C1 | .022UF 10% 400V | 13606 | 4PS-S22 | 321202230 |
| C2 | 100UF 00 16V | 13606 | TE-1162 | 300201071 |
| C3 | 50UF 00 25V | 13606 | TE1209 | 300205062 |
| J1 | 10 PIN DUAL R/A PC | AMPHENOL | 22521021105 | 651703600 |
| R1 | 47K 1W 10% | 01121 | TYPE GB | 200304736 |
| R2 | 1K 1/4W 10% | 01121 | TYPE CB | 200101026 |
| R3 | 4.7K 1/4W 10% | 01121 | TYPE CB | 200104726 |
| R4 | 1.8K 1/4W 10% | 01121 | TYPE CB | 200101826 |
| R5 | 3.3K 1/4W 10% | 01121 | TYPE CB | 200103326 |
| R6 | SAME AS R5 | | | |
| R7 | SAME AS R5 | | | |
| R8 | SAME AS R5 | | | |
| R9 | SAME AS R5 | | | |

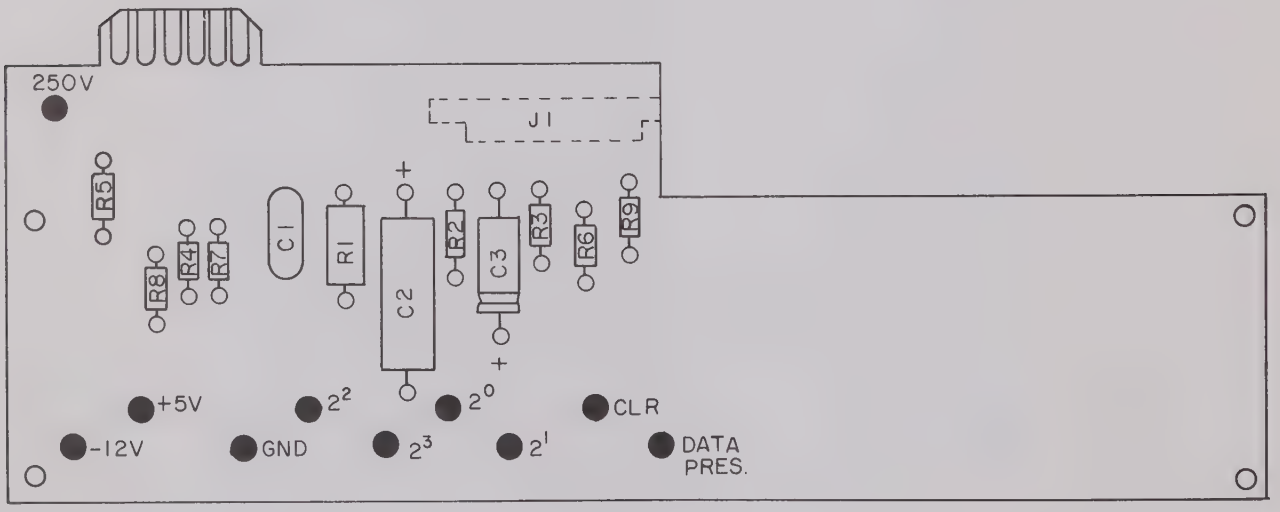
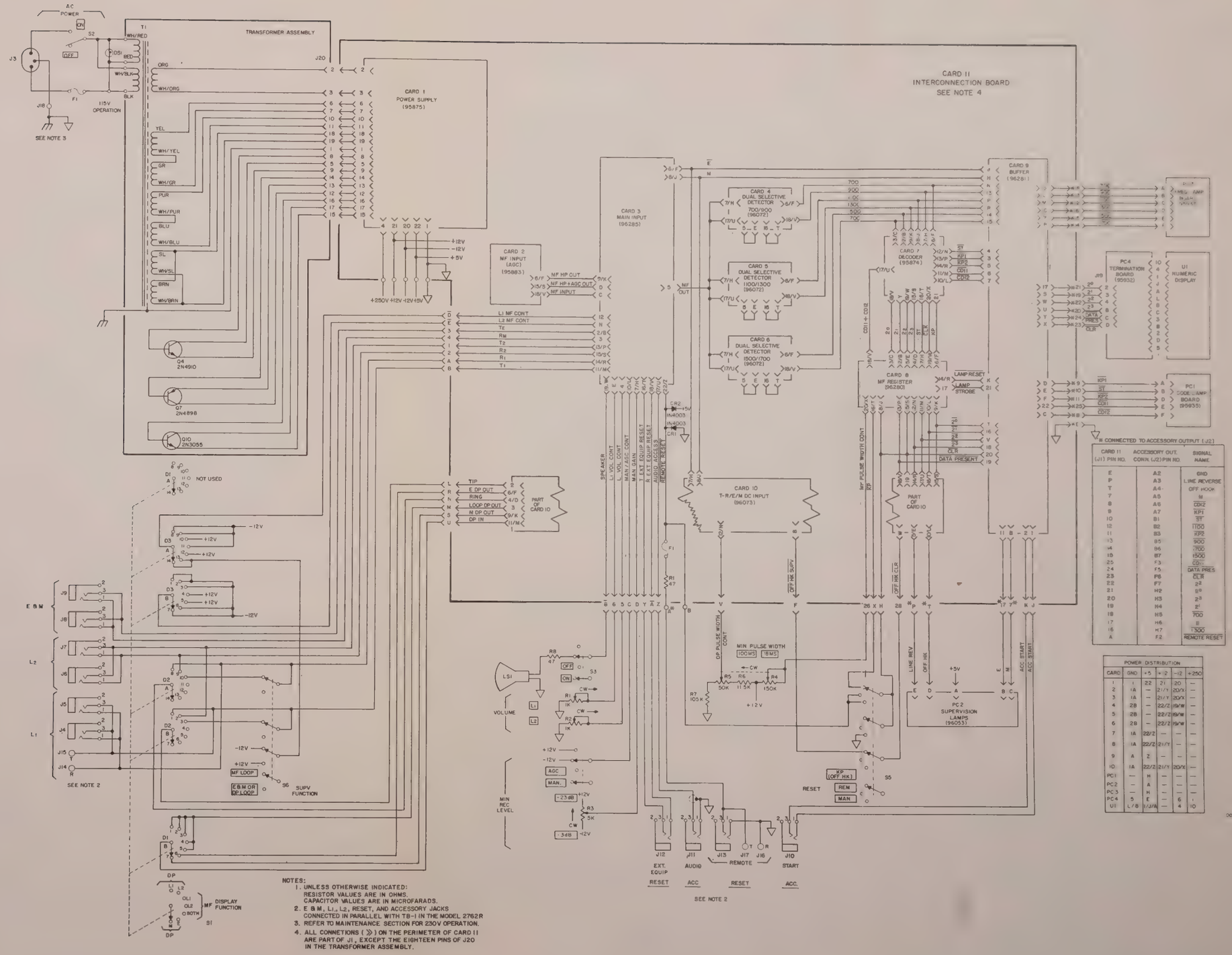



Figure 6—14. TTS 2762, Termination Board PC4 (95932), Component Location

# SCHEMATIC DIAGRAMS

## 7.1 INTRODUCTION.

7.2 This section provides the schematic diagrams, figures 7–1 through 7–13, for the TTS 2762 and TTS 2762R MF and Loop Signaling Display Units.




NOTES:
1. UNLESS OTHERWISE INDICATED:
   RESISTOR VALUES ARE IN OHMS.
   CAPACITOR VALUES ARE IN MICROFARADS.
2. E & M, L1, L2, RESET, AND ACCESSORY JACKS CONNECTED IN PARALLEL WITH T8-1 IN THE MODEL 2762R
3. REFER TO MAINTENANCE SECTION FOR 230V OPERATION.
4. ALL CONNETIONS ( ⟩⟩ ) ON THE PERIMETER OF CARD II ARE PART OF J1, EXCEPT THE EIGHTEEN PINS OF J20 IN THE TRANSFORMER ASSEMBLY.

**Figure 7–1. TTS 2762, Overall Schematic Diagram**

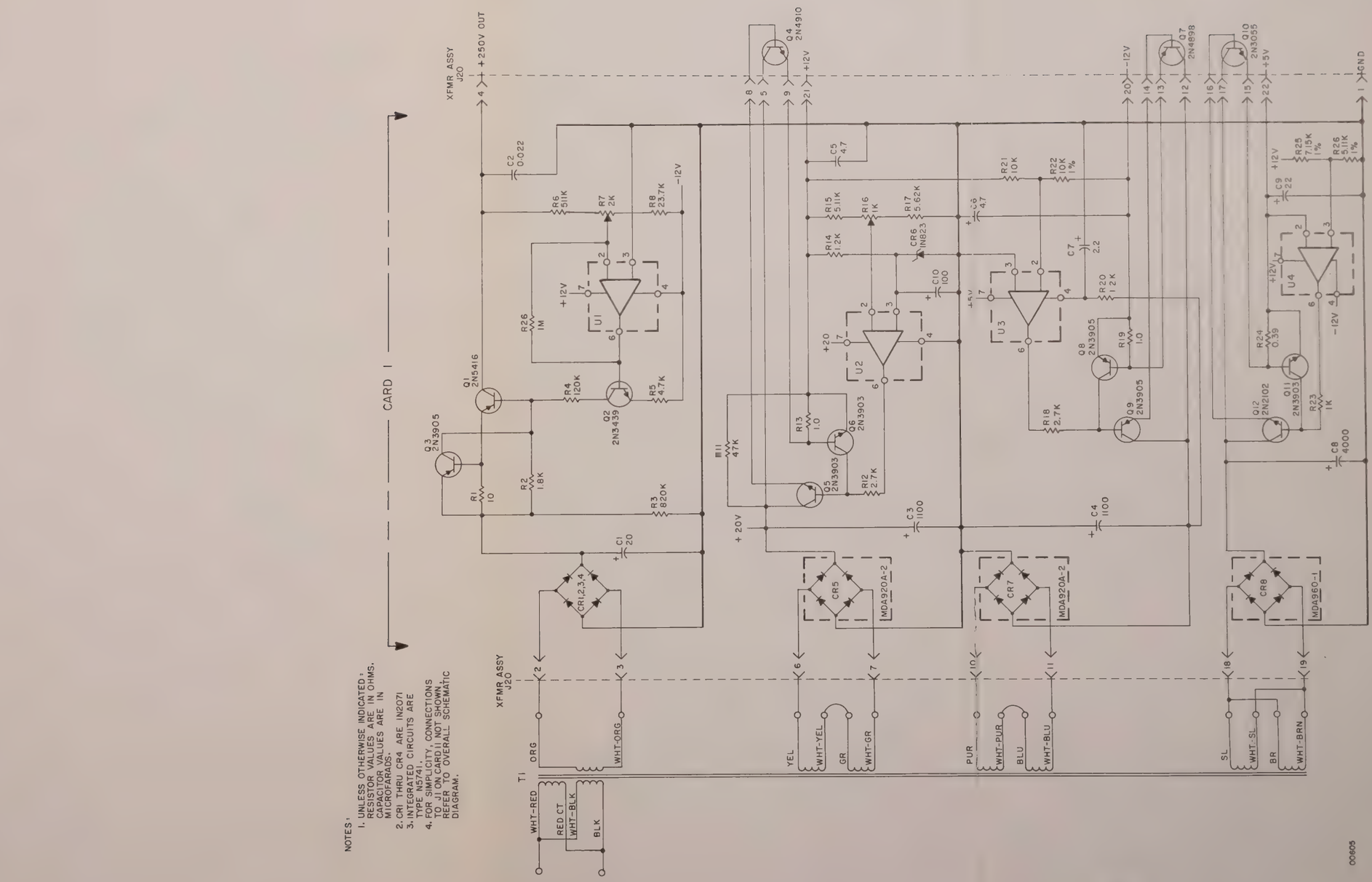
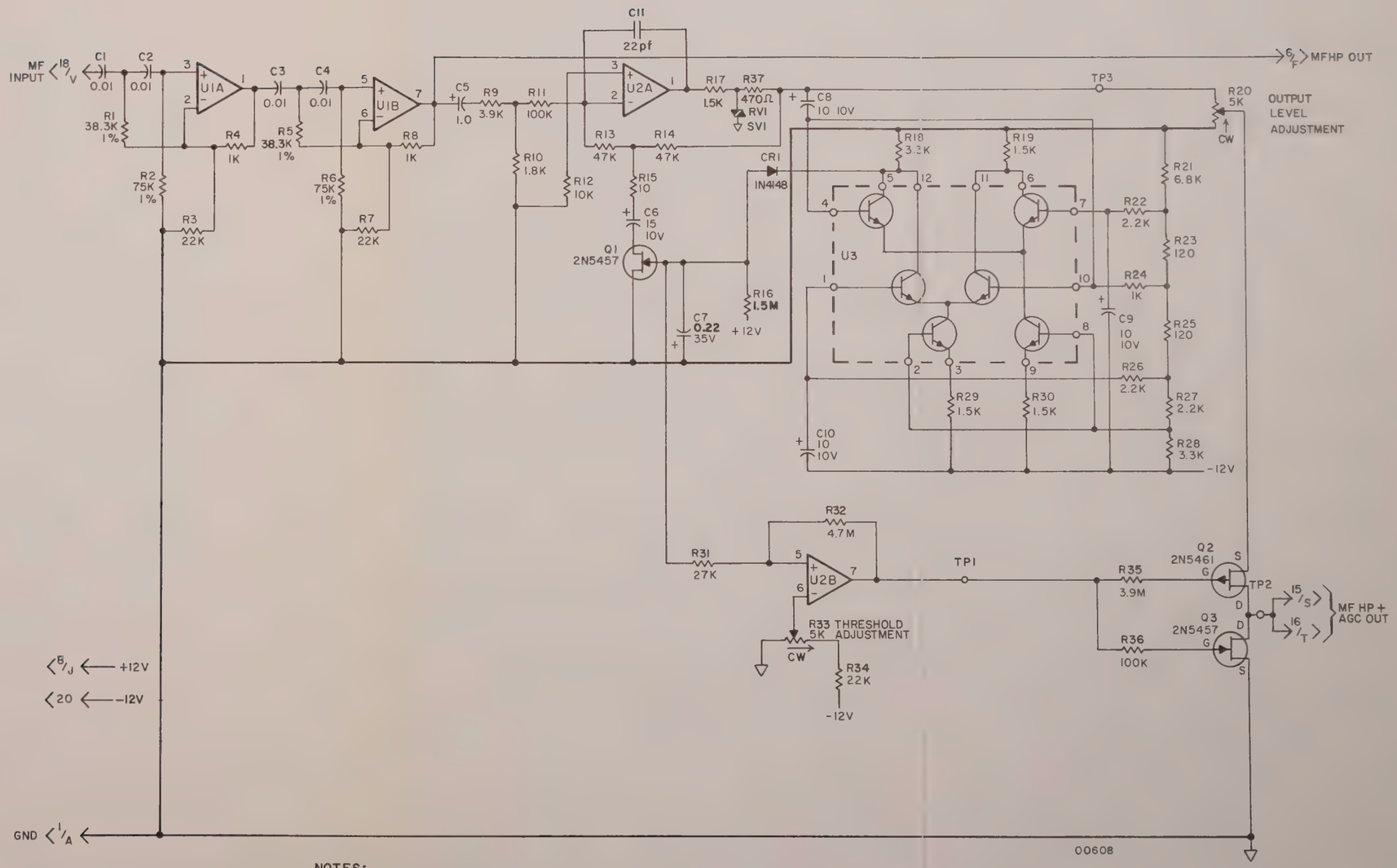



**Figure 7–2. TTS 2762, Power Supply, Card 1, Schematic Diagram**




| | TYPE | +V | -V |
|---|---|---|---|
| U1-U2 | N5558V | 8 | 4 |
| U3 | CA3026 | | |

NOTES:
1. UNLESS OTHERWISE INDICATED:
   RESISTOR VALUES ARE IN OHMS.
   CAPACITOR VALUES ARE IN MICROFARADS.
   INDUCTANCE VALUES ARE IN MILLIHENRYS.
2. MAX REFERENCE DESIGNATIONS USED: R37, C11, U3, Q3, RV1, CR-1.

**Figure 7–3. TTS 2762, MF Input (AGC) Card 2, Schematic Diagram**

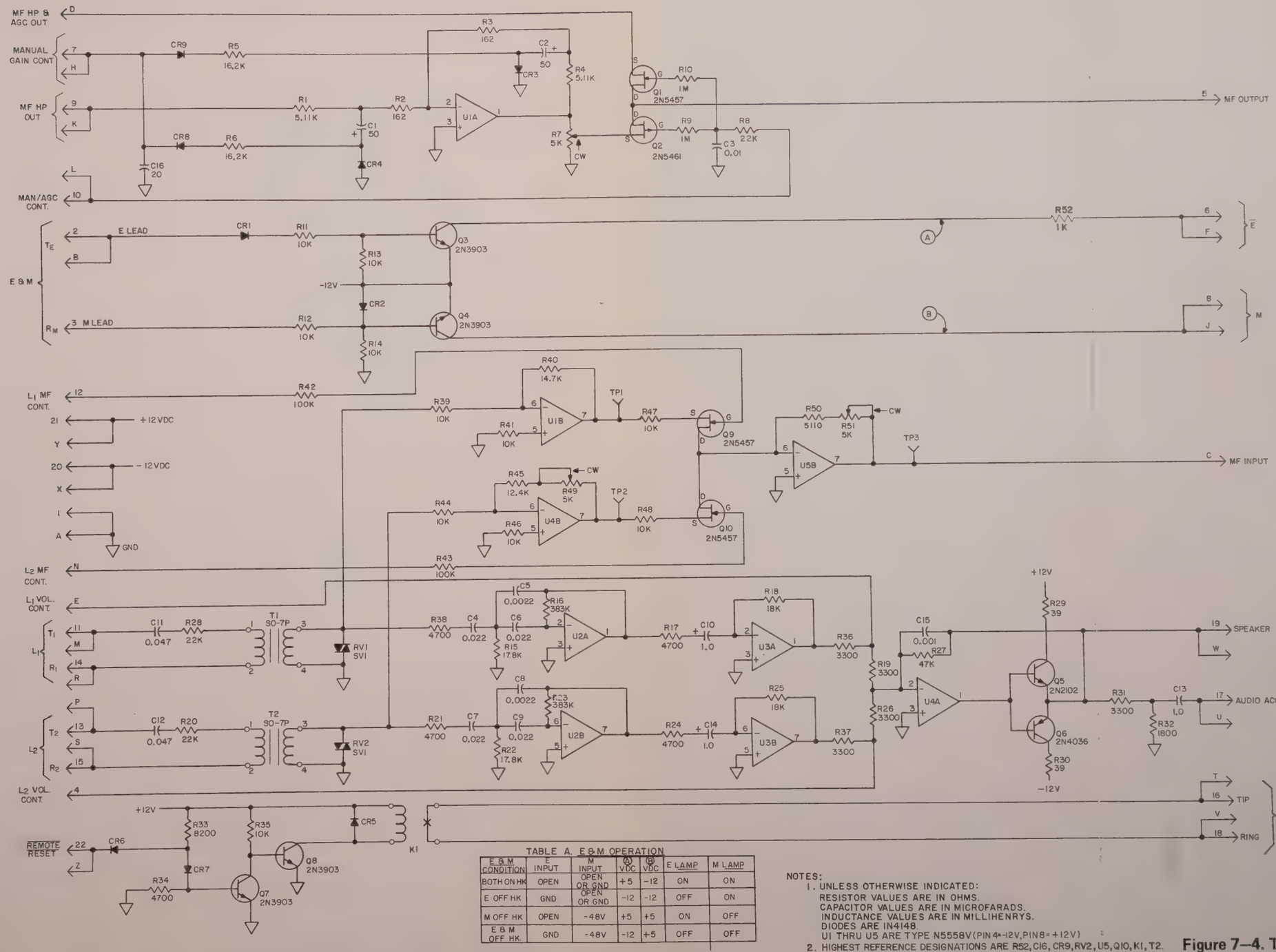


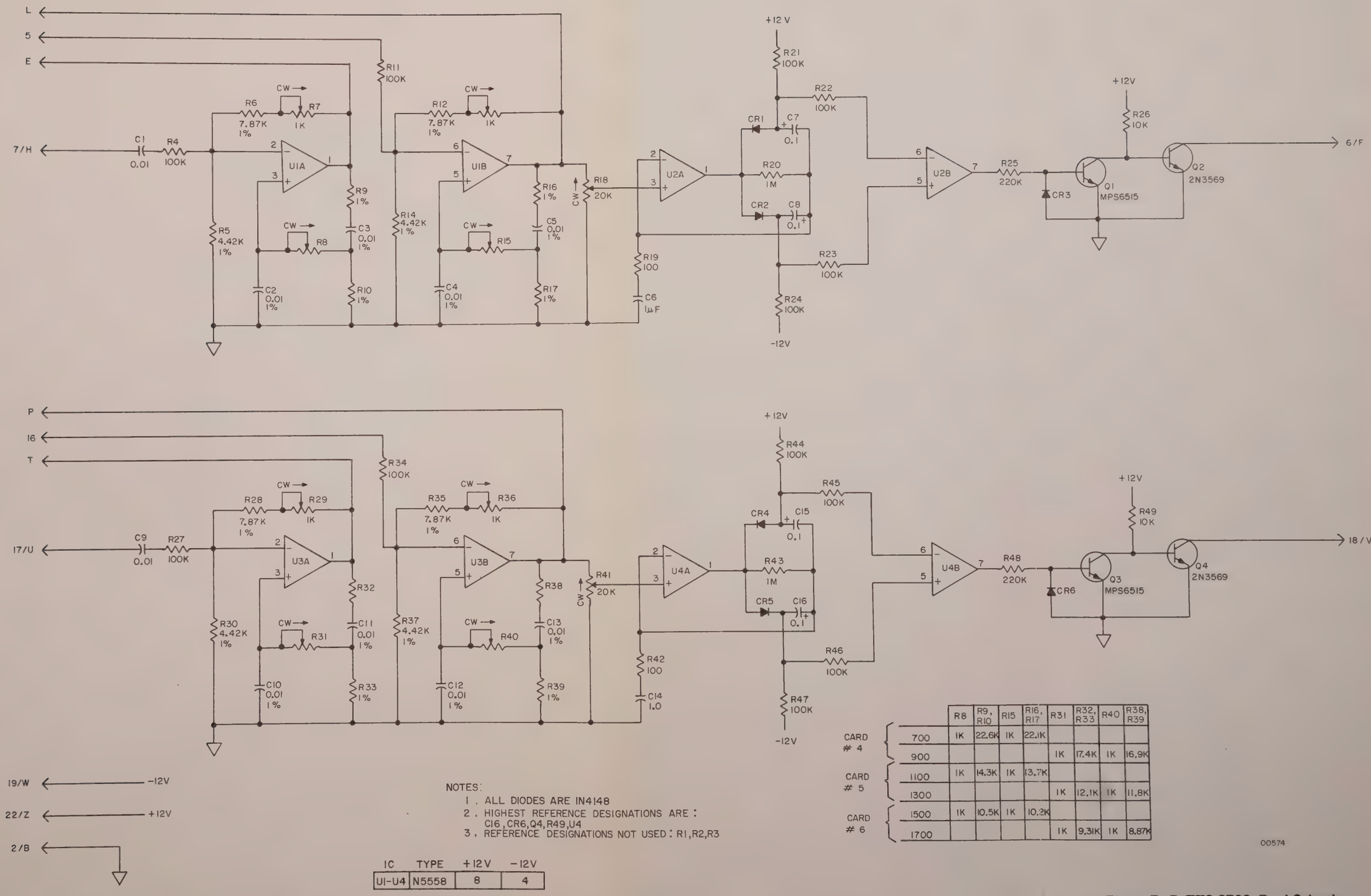

TABLE A. E & M OPERATION

| E & M CONDITION | E INPUT | M INPUT | Ⓐ VDC | Ⓑ VDC | E LAMP | M LAMP |
|---|---|---|---|---|---|---|
| BOTH ON HK | OPEN | OPEN OR GND | +5 | -12 | ON | ON |
| E OFF HK | GND | OPEN OR GND | -12 | -12 | OFF | ON |
| M OFF HK | OPEN | -48V | +5 | +5 | ON | OFF |
| E & M OFF HK | GND | -48V | -12 | +5 | OFF | OFF |

NOTES:
1. UNLESS OTHERWISE INDICATED:
   RESISTOR VALUES ARE IN OHMS.
   CAPACITOR VALUES ARE IN MICROFARADS.
   INDUCTANCE VALUES ARE IN MILLIHENRYS.
   DIODES ARE IN4148.
   U1 THRU U5 ARE TYPE N5558V (PIN 4=-12V, PIN 8=+12V)
2. HIGHEST REFERENCE DESIGNATIONS ARE R52, C16, CR9, RV2, U5, Q10, K1, T2.

SCHEMATIC DIAGRAM
MAIN INPUT BOARD
CARD 3, 96285
2762

**Figure 7–4. TTS 2762, Main Input Board, Card 3, Schematic Diagram**




NOTES:
1. ALL DIODES ARE IN4148
2. HIGHEST REFERENCE DESIGNATIONS ARE: C16, CR6, Q4, R49, U4
3. REFERENCE DESIGNATIONS NOT USED: R1, R2, R3

| IC | TYPE | +12V | -12V |
|---|---|---|---|
| U1-U4 | N5558 | 8 | 4 |

| | | R8 | R9, R10 | R15 | R16, R17 | R31 | R32, R33 | R40 | R38, R39 |
|---|---|---|---|---|---|---|---|---|---|
| CARD # 4 | 700 | 1K | 22.6K | 1K | 22.1K | | | | |
| | 900 | | | | | 1K | 17.4K | 1K | 16.9K |
| CARD # 5 | 1100 | 1K | 14.3K | 1K | 13.7K | | | | |
| | 1300 | | | | | 1K | 12.1K | 1K | 11.8K |
| CARD # 6 | 1500 | 1K | 10.5K | 1K | 10.2K | | | | |
| | 1700 | | | | | 1K | 9.31K | 1K | 8.87K |

00574

**Figure 7–5. TTS 2762, Dual Selective Detector Cards 4,5, and 6 Schematic Diagram**

| | VCC | GND | TYPE |
|---|---|---|---|
| U1 | 4 | 11 | MC9718P |
| U2 – U6 | 8 | 1 | SN377A |
| U7 – U10 | 8 | 1 | SP384 |
| U11 | 14 | 7 | SN7430N |
| U12 | 14 | 7 | SN7420N |
| U13 | 14 | 7 | SN7400N |
| U14 | 8 | 1 | SP314A |
| U15 | 14 | 7 | SN7403N |

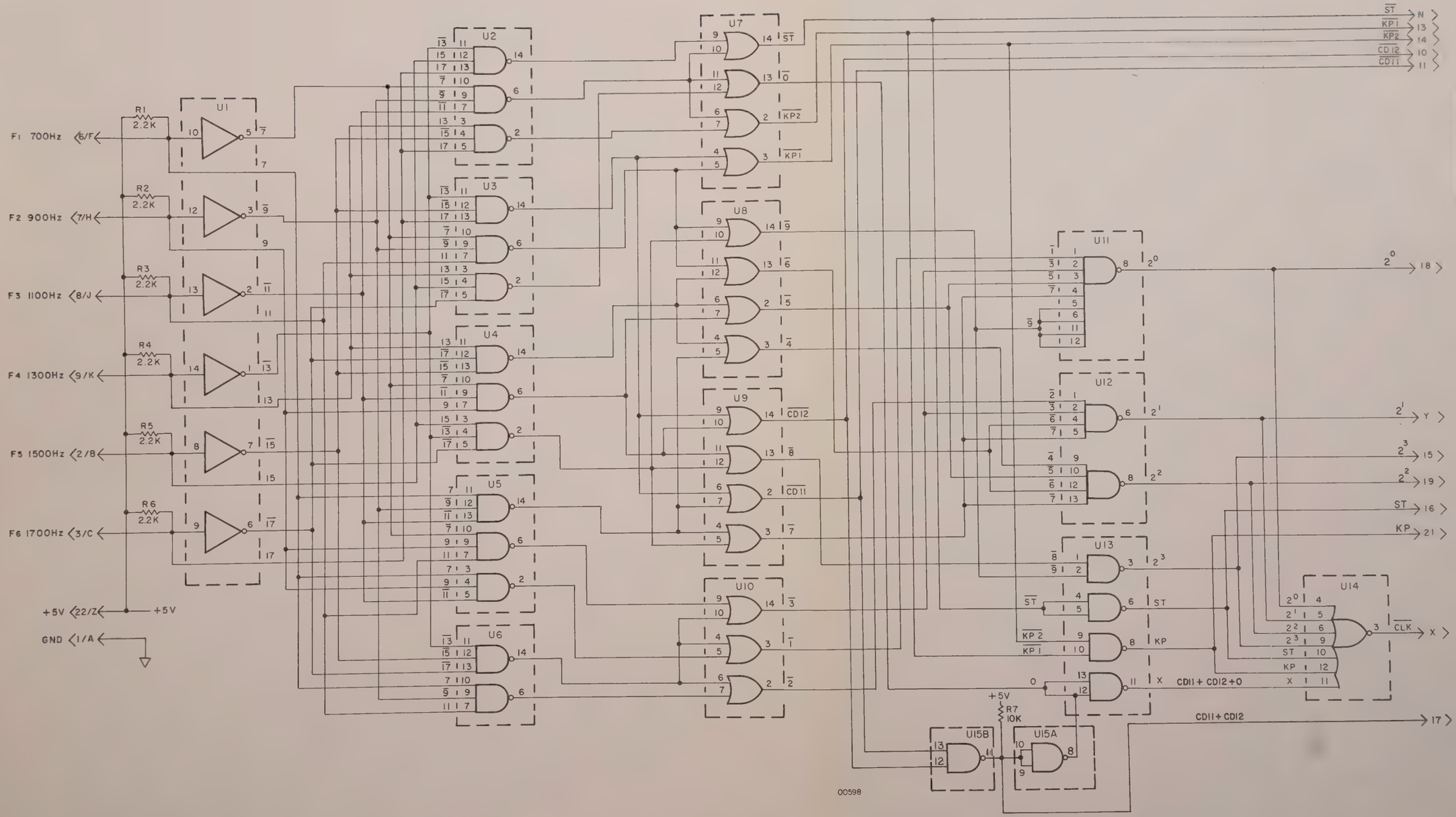
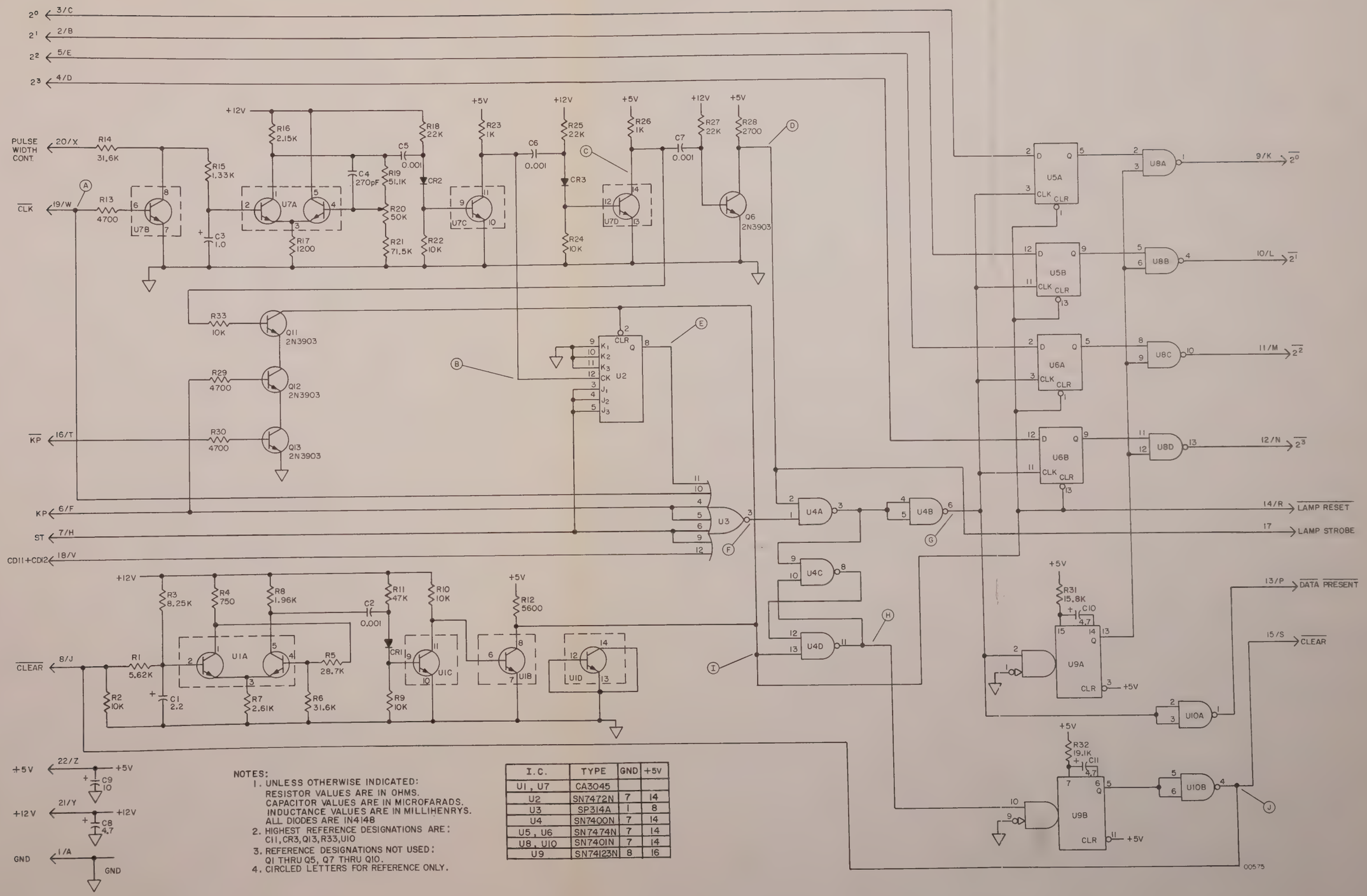


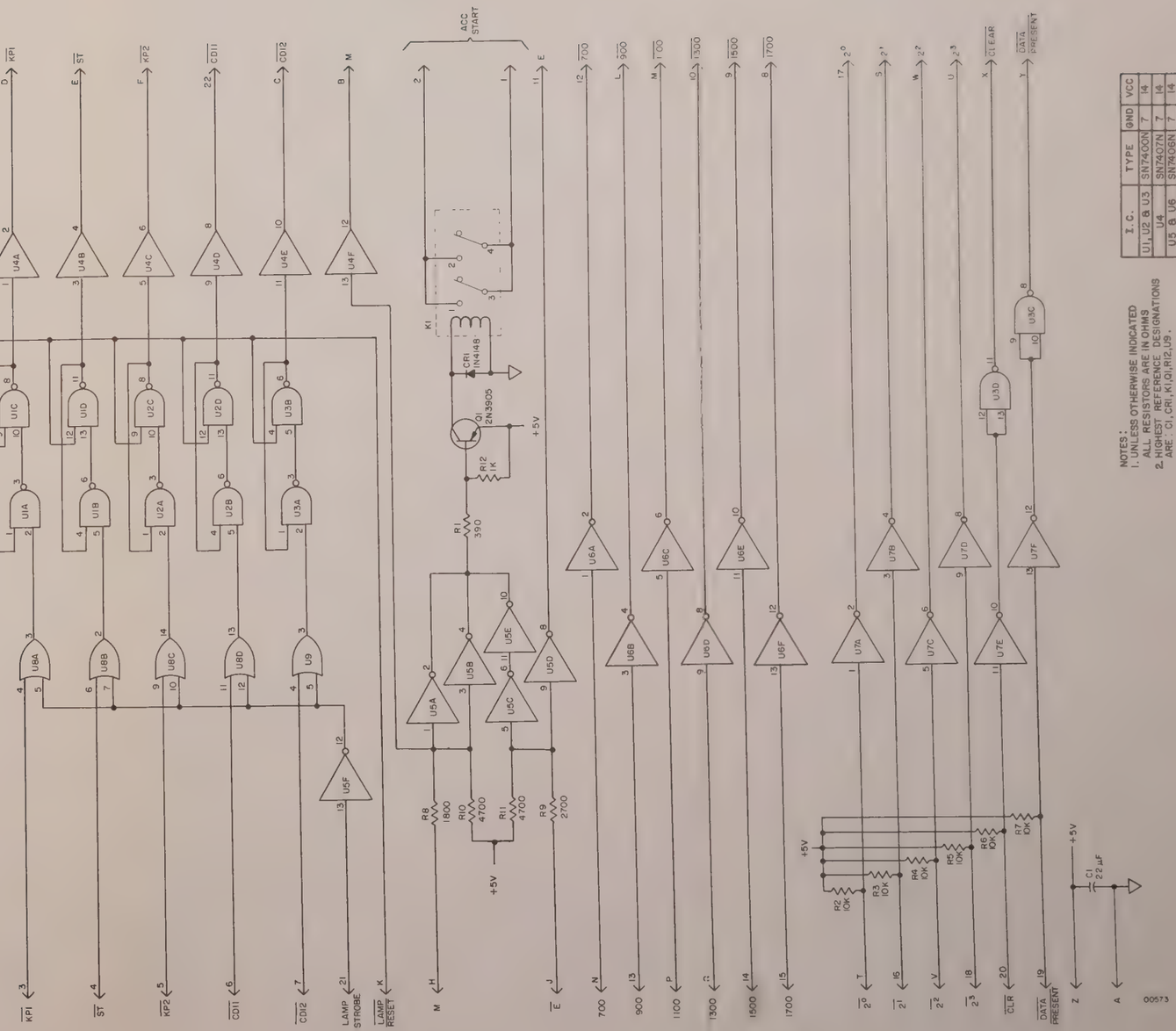

Figure 7–6. TTS 2762, Decoder Card 7, Schematic Diagram




NOTES:
1. UNLESS OTHERWISE INDICATED:
   RESISTOR VALUES ARE IN OHMS.
   CAPACITOR VALUES ARE IN MICROFARADS.
   INDUCTANCE VALUES ARE IN MILLIHENRYS.
   ALL DIODES ARE IN4148
2. HIGHEST REFERENCE DESIGNATIONS ARE:
   C11, CR3, Q13, R33, U10
3. REFERENCE DESIGNATIONS NOT USED:
   Q1 THRU Q5, Q7 THRU Q10.
4. CIRCLED LETTERS FOR REFERENCE ONLY.

| I.C. | TYPE | GND | +5V |
|---|---|---|---|
| U1, U7 | CA3045 | | |
| U2 | SN7472N | 7 | 14 |
| U3 | SP314A | 1 | 8 |
| U4 | SN7400N | 7 | 14 |
| U5, U6 | SN7474N | 7 | 14 |
| U8, U10 | SN7401N | 7 | 14 |
| U9 | SN74123N | 8 | 16 |

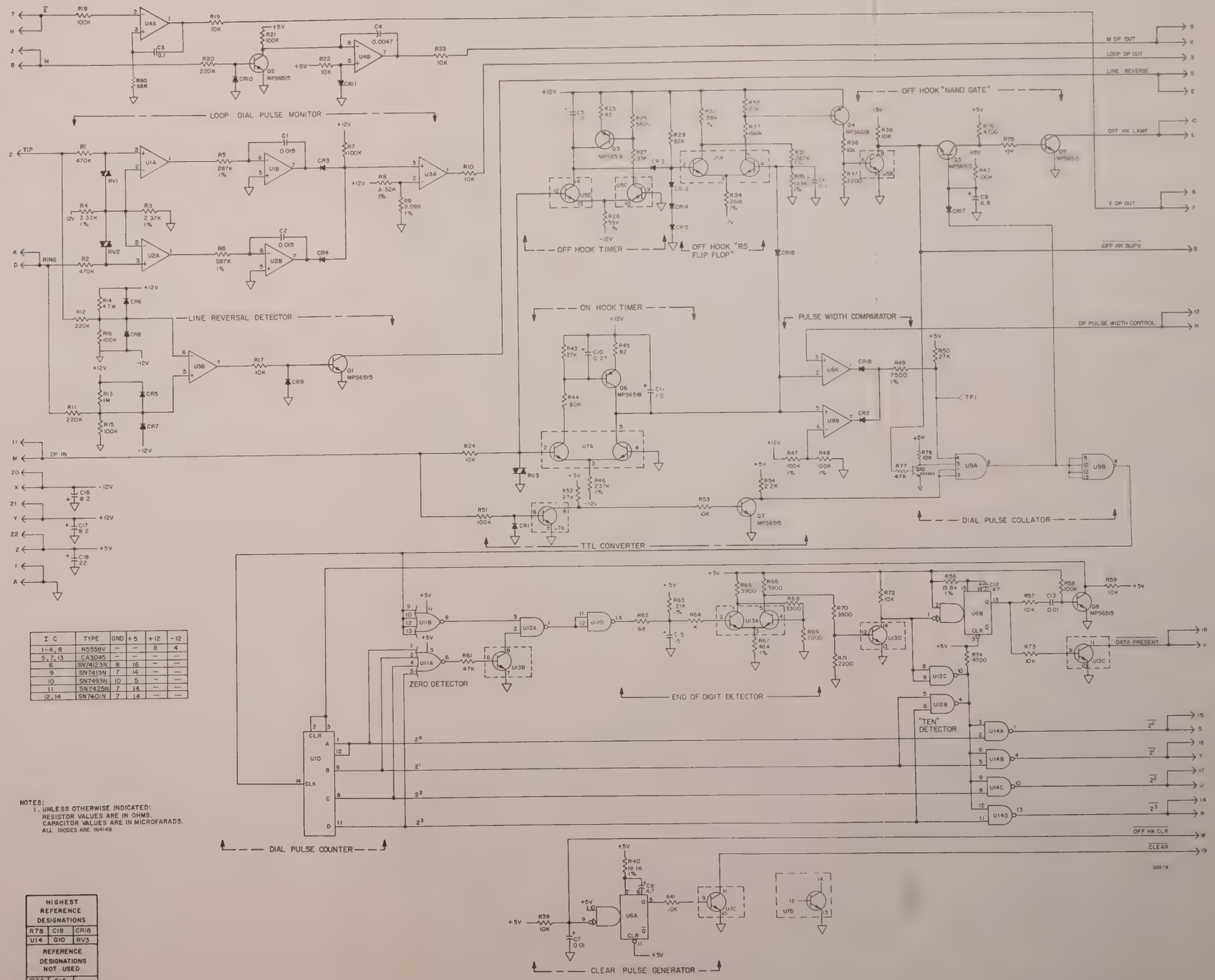
**Figure 7–7. TTS 2762, MF Register Board Card 8, Schematic Diagram**




NOTES:
1. UNLESS OTHERWISE INDICATED ALL RESISTORS ARE IN OHMS
2. HIGHEST REFERENCE DESIGNATIONS ARE: C1, CR1, K1, Q1, R12, U9.

| I.C. | TYPE | GND | VCC |
|---|---|---|---|
| U1, U2 & U3 | SN7400N | 7 | 14 |
| U4 | SN7407N | 7 | 14 |
| U5 & U6 | SN7406N | 7 | 14 |
| U7 | SN7404N | 7 | 14 |
| U8 & U9 | SP3864A | 1 | 8 |

**Figure 7–8. TTS 2762, Buffer Card 9, Schematic Diagram**

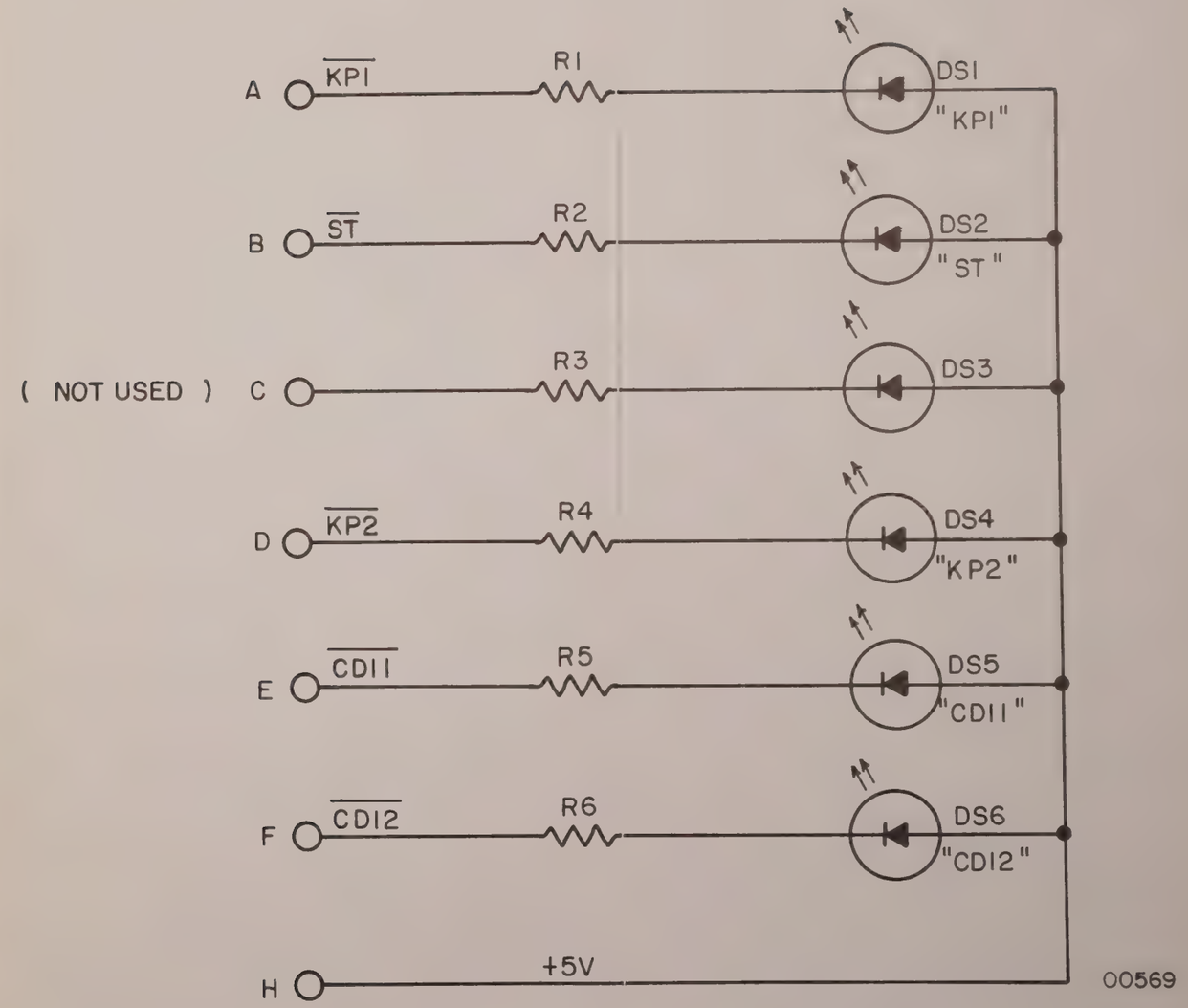



| I C | TYPE | GND | +5 | +12 | -12 |
|---|---|---|---|---|---|
| 1-4, 8 | N5558V | — | — | 8 | 4 |
| 5, 7, 13 | CA3045 | — | — | — | — |
| 6 | SN74123N | 8 | 16 | — | — |
| 9 | SN7413N | 7 | 14 | — | — |
| 10 | SN7493N | 10 | 5 | — | — |
| 11 | SN7425N | 7 | 14 | — | — |
| 12, 14 | SN7401N | 7 | 14 | — | — |

NOTES:
1. UNLESS OTHERWISE INDICATED:
   RESISTOR VALUES ARE IN OHMS.
   CAPACITOR VALUES ARE IN MICROFARADS.
   ALL DIODES ARE IN4148

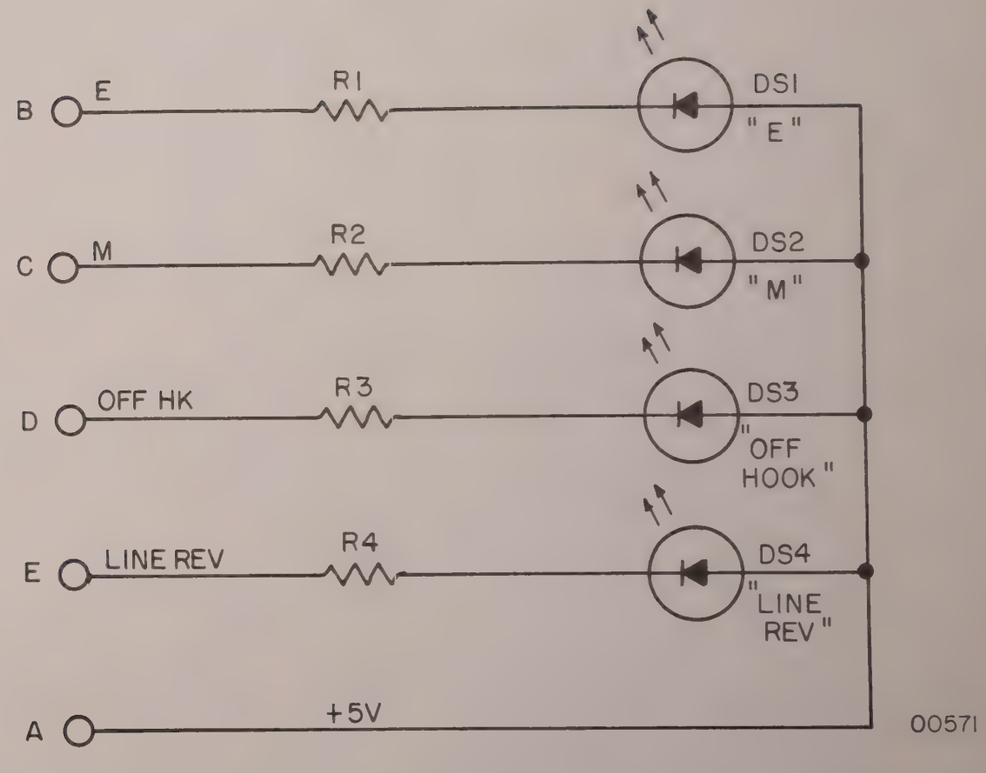
| HIGHEST REFERENCE DESIGNATIONS | | |
|---|---|---|
| R78 | C18 | CR18 |
| U14 | Q10 | RV3 |
| REFERENCE DESIGNATIONS NOT USED | | |
| R55 | C14 | |
| | | |

Figure 7–9. TTS 2762, T–R/E/M
DC Input Card 10, Schematic Diagram



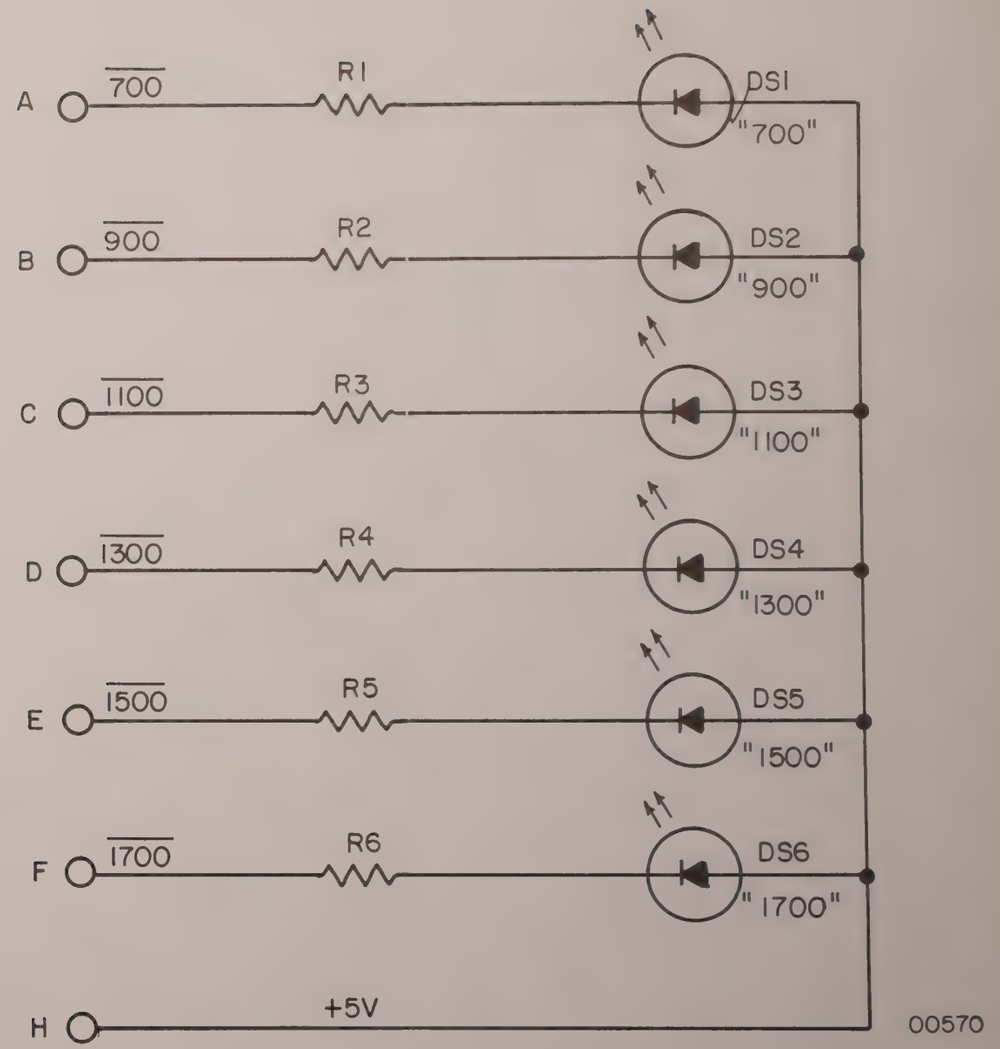

NOTE:
ALL RESISTORS ARE 100 OHMS.

**Figure 7–10. TTS 2762, Code Lamp Board PC1, Schematic Diagram**



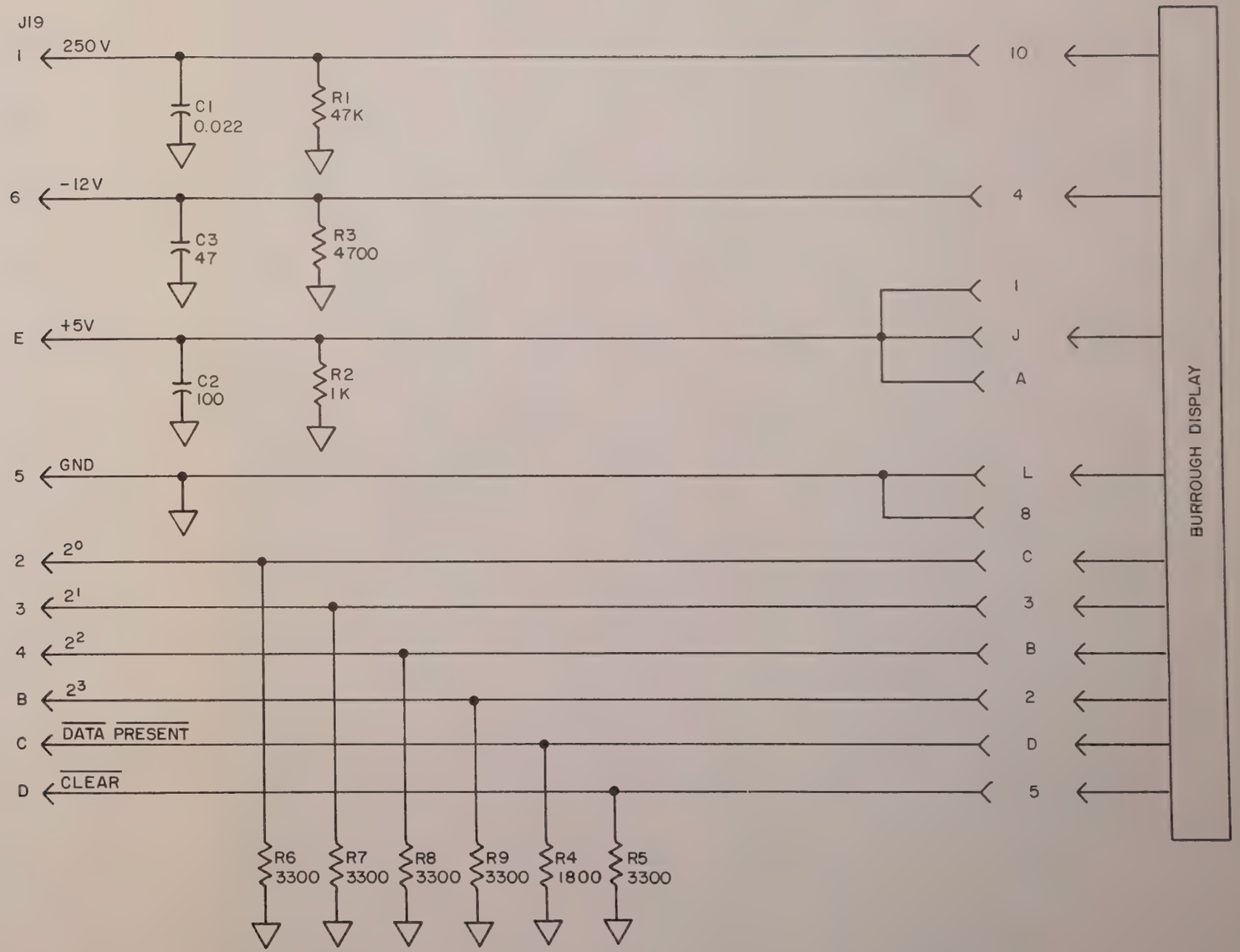

NOTE:
ALL RESISTORS ARE 100 OHMS.

Figure 7–11. TTS 2762, Supervision Lamp Board PC2, Schematic Diagram




NOTE:
ALL RESISTORS ARE 100 OHMS.

**Figure 7–12. TTS 2762, Frequency Lamp Board PC3, Schematic Diagram**




NOTES:
1. UNLESS OTHERWISE INDICATED:
   RESISTOR VALUES ARE IN OHMS.
   CAPACITOR VALUES ARE IN MICROFARADS.

Figure 7–13. TTS 2762, Termination Board PC4, Schematic Diagram

# Model TTS 2762 ERRATA

12–19–73

Add C11 to Table 6–5, TTS 2762, MF Input, Card 2 (95883) Parts List:

| | | | | | | |
|---|---|---|---|---|---|---|
| C11 | 22pF | 10% | 1KV | 71590 | DD–20 | 330002200 |

TTS 2762 Errata

1–31–74

1. Changes in Section 4 are as follows:

a. Page 4–11, paragraph 4.92, sentence;
"The E signal is inverted by integrator U4A for those transients lasting longer than approximately one millisecond."

Change:

1. "integrator U4A" to "latch U4A."
2. "one millisecond" to "seven milliseconds."

b. Page 4–12, paragraph 4.98, last sentence, change "pin 3" to "pin 2."

2. Deletions, changes, and additions in Section 6 are as follows:

a. In table 6–5, TTS 2762,MF Input, Card 2 (95883) Parts List, change components C7 and R16 as follows:

| | | | | | |
|---|---|---|---|---|---|
| C7 | 0.22μF 10% 50V | 05397 | T330A224K050AS | 310002240 |
| R16 | 1.5M ¼ 10% | 01121 | Type CB | 200101556 |

b. In table 6–5, add:

| | | | | | |
|---|---|---|---|---|---|
| C11 | 22pF 10% 1KV | 71590 | DD–220 | 330002200 |

c. In table 6–6, TTS 2762, Main Input, Card 3 (96285) Parts List, add:

| | | | | |
|---|---|---|---|---|
| R52 | 1K ¼W 10% | 01121 | Type CB | 200101026 |

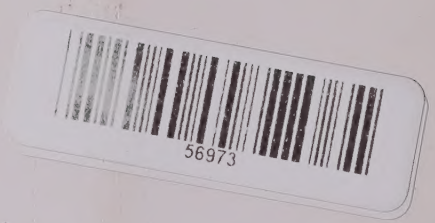
d. In table 6–13, TTS 2762, T–R/E/M DC Input, Card 10 (96073) Parts List, perform the following:

1. Delete: Components R55 and C14.
2. Change Reference Designator R3 to R39.
3. Change components C3,R50,R54,R60, and U9, as follows:

| | | | | | |
|---|---|---|---|---|---|
| C3 | 0.1μF | 10% 100V | 13606 | 225P10491WD3 | 320001040 |
| R50 | 27K | ¼W 10% | 01121 | Type CB | 200102736 |
| R54 | 2.2K | ¼W 10% | 01121 | Type CB | 200102226 |
| R60 | 68K | ¼W 10% | 01121 | Type CB | 200106836 |
| U9 | 14PDIL | 00 | 01295 | SN7413N | 510074130 |

4. Add components Q10,R77 and R78, as follows:

| | | | | | |
|---|---|---|---|---|---|
| Q10 | TO92HSS | 310MW | 04713 | 2N3903 | 550039030 |
| R3 | 2370Ω | 1/8W 1% | 19701 | MF5C | 220223711 |
| R77 | 47K | ¼W 10% | 01121 | Type CB | 200106806 |
| R78 | 10K | ¼W 10% | 01121 | Type CB | 200101036 |


56973